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THESIS

MISSILE DEFENSE CERTIFICATION: EXAMINATION OF THE U.S. NAVY AEGIS WARSHIP AND U.S. ARMY PATRIOT CREW CERTIFICATION PROCESS

by

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September 2008

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I. INTRODUCTION

A. PURPOSE OF THESIS

The proliferation of weapons of mass destruction, and the threat these weapons pose to regional and homeland defense, pose a critical challenge to the Department of Defense. The Global War on Terrorism (GWOT) has been marked by conventional warfare and urban insurgency to date; the exchange of ballistic missiles has not been part of the GWOT equation. Yet the consequences of a ballistic missile exchange are not any less and the likelihood of such an exchange may in fact be greater. For over thirty years the United States has conducted a scientifically challenging and aggressive initiative to mitigate this threat culminating in the fielding of the Ballistic Missile Defense System (BMDS). This system is the compilation of individual military service components in to an interoperable and responsive defensive shield.

The ballistic missile defense capability is one of the major pieces of the Department of Defense's New Triad[1]. Each combatant commander is responsible for the operation of the Ballistic Missile Defense component in their assigned region with Strategic Command (STRATCOM) assigned the responsibility of global coordination. Individual elements of the system are operated by the parent service or the Missile Defense Agency (MDA). Strategic Command directive SD 508-8 established a program for the certification and qualification for operational units in December 2004. Parent services provide the guidance for their elements. This paper will examine the overarching guidance provided to two service elements, the U.S. Navy Aegis Ballistic Missile Defense program warships and the U.S. Army Air Defense Artillery Patriot Battalions. The parent service certification program is potentially vital to national security in the event of hostile missile employment.

[1] The New Triad consists of conventional precision-guided weapons, a responsive defensive infrastructure, and both active and passive defensive mechanisms. The BMDS is key to the active mechanism leg of the Triad. "The New Triad." http://www.nti.org/f_wmd411/f2c2.html. Accessed August 11, 2008.

B. RESEARCH QUESTIONS

One might ask what exactly does certification mean in the context of military readiness? The most appropriate definition is available in SD 508-8. The directive describes three terms: Qualification, Certification, and Mission Ready. Qualification is achieved by demonstrating proficiency in a particular knowledge or skill area to an established standard. Certification is a culminating event designating qualified crews or teams as approved for operational missions. Mission Ready is a Commander's assessment of Doctrine, Organization, Training, Materiel, Leadership, Personnel, and Facilities (DOTMLPF) against Joint Mission Essential Tasks. It is important to note that a system certification is outside the realm of the operational commander. The parent service levies requirements on their units to periodically demonstrate certification criteria as part of the larger process of force deployment.

Using the STRATCOM directive as explicit guidance, we can explore what the services do with the information obtained during the typically continuous process of certification. The availability of information from the certification process to the parent service and STRATCOM is determined by the mechanisms employed by the services to record and monitor status. This raises the question: what mechanism is in place to allow for monitoring of units as they proceed through the process?

1. Certification Process

The Ballistic Missile Defense System is a Joint system by design. It is reasonable to examine the elements of the BMDS with the goal of discovering how similar the certification path is for the individual elements. In the case of the Aegis element, the Navy's certification program is predominantly defined by the Surface Force Type Commander. An Air Defense Artillery Patriot Battalion will certify utilizing guidance from the Army Training and Doctrine Command. This thesis investigates the degree of alignment between these two processes and if they support Strategic Command guidance for the BMDS.

2. Technology as a Knowledge Multiplier

It is important to document the events of interest along the certification timeline so that this information can be used to analyze and improve the certification process and the supporting processes that provide resources to the warfighter. Units are required to report their status at regular intervals and when their status has been upgraded or downgraded based on readiness and materiel condition among other things. The status report is not a substitute for the ability to capture corporate memory. Information Technology offers an avenue for doing just that. In a similar vein, it is common for commanders at many levels to submit some form of post-event After Action or Lessons Learned report. While not always the case, many times these reports do not provide granular information on the progress of individual crews. The reports describe 'why' but not 'who.' This thesis examines how the two Ballistic Missile Defense elements leverage technology to capture information along the certification timeline.

C. THESIS ORGANIZATION

Chapter II provides a brief history of recent treaties that shaped the missile defense environment and describe the change in organizational doctrine that has led to the unified Joint force of today. It also describes the role of the Navy and the Army in missile defense, with particular emphasis on the Aegis and Patriot platforms.

Chapter III reviews the literature that governs the certification process of the overall Ballistic Missile Defense System. The scope will include the overarching guidance down to the unit level instructions that provide the Component Commanders with certified forces.

Chapter IV examines the concept of corporate memory and how the Aegis and Patriot community capture data during the certification process for future use by readiness managers. This chapter also covers models that define process maturity that may be relevant when attempting to discover where a given certification process is at present.

Chapter V summarizes the research and provides recommendations based on the results of that research. The thesis concludes with recommendations for further study.

D. THESIS METHODOLOGY

The Ballistic Missile Defense System is complex and an evaluation of the system from any number of views can be problematic due to the collaborative approach for development and operation employed by the Missile Defense Agency and the military services. The system is actually a system of systems with a global span. This thesis will focus on only two elements of the system, chosen by maturity and capability. The Aegis warship and the Patriot battalion share similar missions and capability. Additionally, both components are unit level assets with similar training and deployment requirements.

This thesis examines the certification requirements that pertain to the chosen elements described above. These requirements include those levied by U.S. Strategic Command, a functional Component Commander, and the service-specific process for 'deployability.' The investigation focuses on the process at the macro level and the measures used to assess proficiency. A secondary focus is examination of the means by which the unit or service captures relevant data in the process of certification and the usefulness and implication that information has for the services.

II. BACKGROUND

A. MISSILE DEFENSE

The modern history of Ballistic Missile Defense can be traced to the Cold War-era Strategic Defense Initiative (SDI). Derided as an expensive pipe dream by critics and hailed as a bulwark against the Soviet nuclear threat by supporters, SDI was a much-discussed item from the Reagan era defense establishment. The collapse of the Soviet Union in 1991 seemed to mark the end of the space-based missile defense discussion at the national and international level. However, advances in technology, particularly missile technology, and the availability of this type of weaponry to 'rogue' nations, terrorist groups and even global competitors have made the subject of missile defense, space-based or not, a topic of interest once again.

The approved architecture of SDI during its initial phase included six major systems:

> a space-based interceptor (SBI), a ground-based interceptor, a ground-based sensor, two space-based sensors, and a battle management system. This architecture provided a structure to guide further refinement of missile defense components that would in turn be integrated into and improve the architecture through an iterative process.[2]

This architecture would have presumably denied the enemy the ability to communicate, provide imagery, and provide warning of impending intercontinental missile strike by negating satellite assets. This provoked controversy domestically and internationally as it seemed to upset the nuclear stalemate of 'mutually assured destruction' as well as elevate the Cold War from the confines of the Earth and spread it to the neutrality of space. The implementation of SDI never blossomed as originally conceived as the end of the Soviet Union changed the focus of national military strategy. Terrorist attacks on September 11, 2001 altered the perception of the missile shield concept as homeland defense and security took on added importance to the United States.

[2] " Ballistic Missile Defense: A Brief History." http://www.mda.mil/mdalink/html/briefhis.html.

In December 2002, President G. W. Bush signed into effect National Security Presidential Directive (NSPD) 23 directing the United States Defense Department, via the Office of Secretary of Defense, to "deploy a set of missile defense capabilities beginning in 2004."[3] This executive action proposed for the deployment of an "initial set of capabilities that…evolve to meet the changing threat and to take advantage of technological developments." Specific mention was made of sea-based and space-based deployment. The Aegis Ballistic Missile Defense program of the U.S. Navy was able to leverage existing Aegis technology to meet the directives intent. NSPD 23 also directed the procurement of additional U.S. Army Patriot PAC-3 units, strengthening that community's ability to provide air defense against theater missiles. The Missile Defense Agency (MDA) took on the burden of executing the directive's intent with the mission:

> …to develop, test and prepare for deployment a missile defense system. Using complementary interceptors, land-, sea-, air- and space-based sensors, and battle management command and control systems, the planned missile defense system will be able to engage all classes and ranges of ballistic missile threats…(The) programmatic strategy is to develop, rigorously test, and continuously evaluate production, deployment and operational alternatives for the ballistic missile defense system. Missile defense systems being developed and tested by MDA are primarily based on hit-to-kill technology.[4]

Merging the individual pieces of the above systems into an overall Ballistic Missile Defense system presented, and still presents, a considerable challenge. Not surprisingly, the parent services assumed responsibility for their portion of the system. Organizations that train and certify operational units have added significance in this construct. More specifically, the certification process enacted by the parent service, or parent community in some cases, takes on the significance of national defense vice unit or force defense. These processes are not Joint by design yet the units that certified via these processes are modules within a system of systems, the Ballistic Missile Defense System. It is imperative that a degree of alignment exists among the various certification processes. Jointness is required to address the global missile threat.

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[3] NSPD 23 December 16, 2002.

[4] "MDA Mission." http://www.mda.mil/mdalink/html/aboutus.html.

B. TREATIES

It is inappropriate to have a legitimate discussion concerning Ballistic Missile Defense without including mention of applicable treaties to which the United States has been a party to. These treaties were intended to level the number of Intercontinental Ballistic Missiles (ICBMs) that the United States and the Soviet Union would retain in their arsenals and generally promote the intent that the two superpowers were making a reasonable effort to cooperate. The treaties fit the original U.S 'nuclear Triad' strategy. More important to the focus of this thesis is that the treaties generally prevented the United States from combining their missile defense components into an integrated system.

1. SALT Treaties

The Strategic Arms Limitation Talks (SALT) between the United States and the Soviet Union from 1969 to 1972 "essentially (froze), at existing levels, the number of strategic ballistic missile launchers, operational or under construction, on each side, and (permitted) an increase in SLBM launchers up to an agreed level for each party, only with the dismantling or destruction of a corresponding number of older ICBMs or SLBM launchers."[5] The agreement known as the SALT I treaty was an interim agreement until a more comprehensive treaty, SALT II, could be confirmed. The SALT II parties agreed to a basic framework in 1974 and received initial signature in 1979. However, the Soviet invasion of Afghanistan in 1980 prompted the United States to withhold official ratification. SALT II became the de facto guidance as both parties abided by the limitations for over a decade.[6]

2. START Treaties

The Strategic Arms Reduction Treaty limited the number of warheads, delivery vehicles, missiles, bombers, as well as imposed restrictions on training, testing and

[5] "Strategic Arms Limitation Talks." http://www.fas.org/nuke/control/salt1/index.html.

[6] "SALT II." http://www.fas.org/nuke/control/salt2/index.html.

modernization. The break up of the Soviet Union prior to the enforcement of the treaty made the subject more complex. Eventually the United States, Russia, the Ukraine, Kazakhstan and Belarus entered into the treaty.[7] The U.S and Russia further agreed to the START II treaty in 2001 which reduced each nuclear arsenal by two-thirds as well as other provisions. [8]

3. 1972 ABM Treaty

The United States and the Soviet Union signed the Anti-Ballistic Missile Treaty on May 26, 1972. This treaty, part of the Strategic Arms Limitation Talks,

> permitted both countries to deploy two fixed, ground-based defenses of 100 missile interceptors each. One defense could protect the national capital, while the second could be used to guard an intercontinental ballistic missile (ICBM) field. In a protocol signed July 3, 1974, the two sides halved the number of permitted defenses. The Soviet Union opted to keep its existing missile defense system around Moscow, while the United States eventually fielded its 100 permitted missile interceptors to protect an ICBM base near Grand Forks, North Dakota…. The United States shut down its permitted ABM defense only months after activating it in October 1975 because the financial costs of operating it were considered too high for the little protection it offered.[9]

The unilateral withdrawal of the United States from the 1972 ABM treaty enabled the development and fielding of the current Ballistic Missile Defense System (BMDS) in place. Described as:

> a collection of Elements and components…integrated to achieve the best possible performance against a full range of potential threats. Formerly, some of these Elements were restricted to act as independent systems. Once the United States withdrew from the Anti-Ballistic Missile Treaty…MDA was able to realize the benefits of integrating complementary, layered elements. [10]

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[7] "Strategic Arms Limitation Talks." http://www.fas.org/nuke/control/start1/index.html.

[8] " Strategic Arms Reduction Treaties." http://www.fas.org/spp/starwars/crs/91-139.htm.

[9] " The ABM Treaty At A Glance." http://www.armscontrol.org/factsheets/abmtreaty.asp.

[10] BMDS Booklet, Missile Defense Agency 2006.

The BMDS "proved its worth when North Korea fired several ballistic missiles into the Sea of Japan …in July (2006). Right before the tests, the Bush administration activated the system as a precaution. Secretary of State Condoleezza Rice and secretary of Defense Robert Gates penned a Daily Telegraph piece claiming that the defense had helped 'promote stability' by allowing U.S. leaders 'to consider a wider, more flexible range of responses to a potential attack'. " [11] In summary, the impetus to deploy the current iteration of the BMDS and its expected follow-on development was generated by the withdrawal of the 1972 treaty.

C. TRANSFORMATION

The Department of Defense embarked upon a series of efforts known as 'transformation' at the onset of the 21st century with the goal of developing a leaner, cost-effective, and more agile fighting force. Some of this can be traced to a previous effort ('the Revolution in Military Affairs' –RMA) as well as the realization that Cold War doctrines and processes were not sufficient to adequately sustain a War on Terror-focused fighting force. The idea of 'jointness' or near seamless integration between the military services, took a prominent position within the transformation circles. As recently as 2003 the Naval Transformational Roadmap named the deployment of a sea-based ballistic missile defense capability as one of the primary efforts towards the establishment of Sea Shield. [12] Additionally, the roadmap declares this to be a 'capability pillar' that supports the Joint Operating Concept (JOC) in the key areas of Major Combat Operations, Strategic Deterrence, and Homeland Security (Table 1). While the transformative effect can be called into question, there is little doubt that the forces of the foreseeable future will undoubtedly be far more joint-oriented than ever before. Ballistic Missile Defense is configured as a system of multiple components across the military services, an indication that, in this warfare mission at least, the joint concept is firmly established.

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[11] Wade Boese. *Arms Control Today.* Jun 2007, Vol.37, Iss.5. Accessed via Proquest Feb 4, 2008.

[12] Naval Transformation Roadmap 2003.

		Major Combat Operations	Stability Operations	Strategic Deterrence	Homeland Security
Sea Shield	Air & Missile Defense	√		√	√
	Anti-Submarine Warfare	√			
	Mine Warfare	√	√		
	Anti-Surface Warfare	√	√		√
	Force Protection	√	√	√	√

Table 1. Contribution of Sea Shield Transformational Initiative to Joint Operational Concepts (From Naval Transformation Roadmap 2003)

1. The Joint Effect

Greater than merely facilitating military coordination, the joint concept integrates doctrine, planning, and force structure as articulated in Joint Vision 2020. This concept may have difficulty becoming executable at more granular levels of operation, but in the arena of Ballistic Missile Defense it experiences a smooth translation. Using the current Missile Defense Agency vision for the Integrated Ballistic Missile Defense System it is evident that this system must be a truly joint system and that the processes that enable the system must be joint wherever possible.

The envisioned architecture includes elements from Command and Control (C2), Sensors, and Weapons with a notable emphasis and ultimate reliance on joint interoperability. Command and Control is achieved via Battle Management communications at select Component Commander levels (Strategic Command, Northern Command, Pacific Command, Central Command, European Command) as well as the National Military Command Center (NMCC). Sensors include Defense Support Program (DSP) satellites and Early Warning radar sites from the Air Force, Army AN/TPY-2 phased array radar platforms and Navy Aegis Ballistic Missile Defense ships. Weapons include the SM-3 missile launched from an Aegis ship, Army Patriot Advanced Capability or Terminal High Altitude Area Defense (THAAD) missiles, and the Air Force Airborne Laser and others.

Figure 1. Integrated Ballistic Missile Defense System Diagram
(From BMDS Booklet; MDA)

D. U.S. NAVY ROLE IN BMD

In the case of the U.S. Navy, the asset most able to deploy as part of the Ballistic Missile Defense system is the Aegis warship. These ships are either of the Ticonderoga Guided Missile Cruiser (CG) class or the Arleigh Burke Guided Missile Destroyer class (DDG), the difference being primarily ship/crew size. An excellent albeit unclassified description of Aegis can be found on the Navy's web site:[13]

> The *Aegis* system was designed as a total weapon system, from detection to kill. The heart of the system is an advanced, automatic detect and track, multi-function phased-array radar, the AN/SPY-1. This high powered (four megawatt) radar is able to perform search, track and missile

[13] " United States Navy Fact File: Aegis Weapon System."
http://www.navy.mil/navydata/fact_display.asp?cid=2100&tid=200&ct=2.

> guidance functions simultaneously with a track capacity of over 100 targets…The computer-based command and decision element is the core of the *Aegis* combat system. This interface makes the *Aegis* combat system capable of simultaneous operation against a multi-mission threat: anti-air, anti-surface and anti-submarine warfare.
>
> The Navy built the first *Aegis* cruisers using the hull and machinery designs of *Spruance* class destroyers. The commissioning of *USS Bunker Hill* (CG 52) opened a new era in surface warfare as the first *Aegis* ship outfitted with the Vertical Launching System (VLS), allowing greater missile selection, firepower and survivability. The improved AN/SPY-1B radar went to sea in *USS Princeton* (CG 59), ushering in another advance in *Aegis* capabilities. In 1980, a smaller ship was designed using an improved sea-keeping hull form, reduced infra-red and radar cross section and upgrades to the *Aegis* Combat System. The first ship of the DDG 51 class, *Arleigh Burke*, was commissioned on the Fourth of July, 1991.

A modification to the existing AN/SPY-1 radar allows the system to conduct missile search at elevations well beyond typical air search radar, thus providing the Navy a formidable asset in the world of ballistic missile defense. The surface fleet Type Commander, responsible for manning, training, and equipping the fleet, in conjunction with the Aegis program office and other stakeholders, created the certification requirements for the first set of BMD-modified ships in response to NPSD 23. The initial tasking was to deploy, or be ready to deploy, for Limited Defensive Operations (LDO) in 2004. The certification requirements were modeled heavily upon the pre-existing requirements manuals already in place for the fleet: the Surface Force Training Manual (for certifications) and the Surface Force Instruction 8820 series (for Tomahawk qualifications). The requirements have since been modified slightly; to date there are seventeen ships certified to conduct Ballistic Missile Defense. In the 2008 Department of the Navy Objectives it is worth noting that the Chief of Naval Operation has the lead on 'operationalizing Theater Ballistic Missile defense naval capability.' [14]

The Navy applies two readiness certifications to equipped Aegis units: one is Ballistic Missile search, the other Ballistic Missile search and engage. Three of the Ticonderoga-class have been modified for the engagement capability via the ability to

[14] Department of the Navy Objectives for FY 2008 AND Beyond.

launch the SM-3 missile. These constitute the inventory of engagement-qualified units. At present, Aegis BMD presents a cost-effective means of providing a mobile capability that leverages the substantial investment made in the Aegis fleet. In the long term Aegis BMD will be able to "integrate its tracking system with ….systems such as Space-Based Infrared System-High (SBIRS-High) satellites, the Space Tracking and Surveillance System (STSS), or the Sea-Based X-Band Radar (SBX)."[15] Present day capability is limited to the equipped units and the C2 system employed by MDA, the specifics of which are beyond the scope and classification of this thesis. In general, the current Aegis Ballistic Missile Defense task is to "assist in the defense of the United States, including Hawaii and Alaska, by providing tracking data to cue other sensors and initiate a Ground-Based Midcourse engagement." [16]

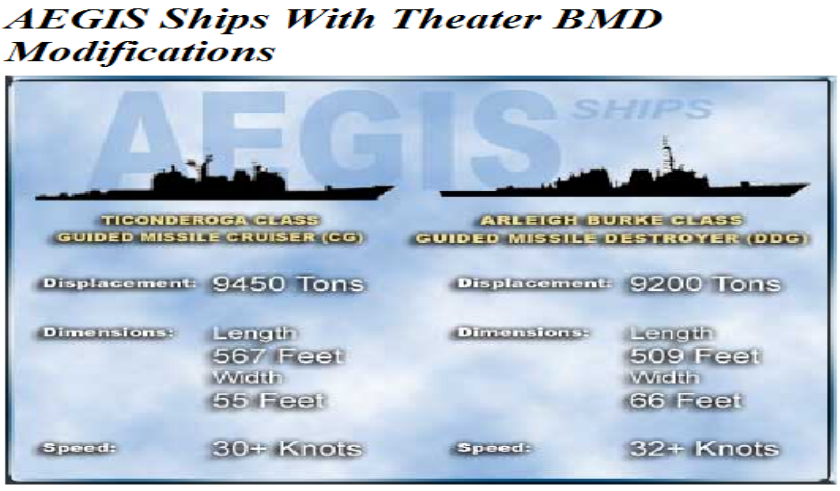

Figure 2. Aegis ship classes and characteristics. (Missile Defense: DefenseLink)

E. U.S. ARMY ROLE IN BMD

The Army has fielded two area defense capabilities relevant to the Ballistic Missile Defense discussion: Theater High Altitude Area Defense (THAAD) and the Patriot system. THAAD is a land-based element with the capability to engage missiles in

[15] Willie Brown. NPS Thesis. Analysis and Design of a Cooperative Weapon Assignment Module for Advanced Battle Manager of a Ballistic Missile Defense System. March 2006.

[16] BMDS Booklet, MDA.

or outside the atmosphere. This element has undergone extensive re-engineering and completed successful trails in 2006 but does not have the same operationally-fielded maturity as the Navy's Aegis elements or another Army element, the Patriot system. THAAD shares similarities with Aegis technology in that is composed of several components and uses a high-resolution, multi-mode, X-band, phased array radar. The radar employs fence, volume, and cued search modes while providing surveillance, acquisition, track, discrimination, missile engagement support, and kill assessment.[17] Figures 3 and 4 provide a display of the major THAAD components.

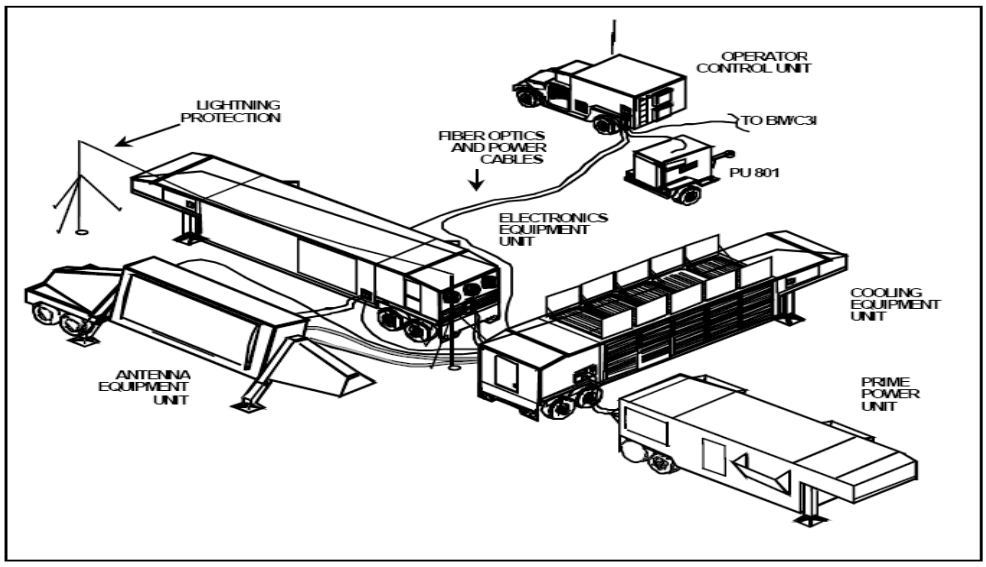

Figure 3. THAAD Radar Components (From FM 3-01.11)

[17] Army Field Manual 3-01.11, Air Defense Artillery Reference Handbook.

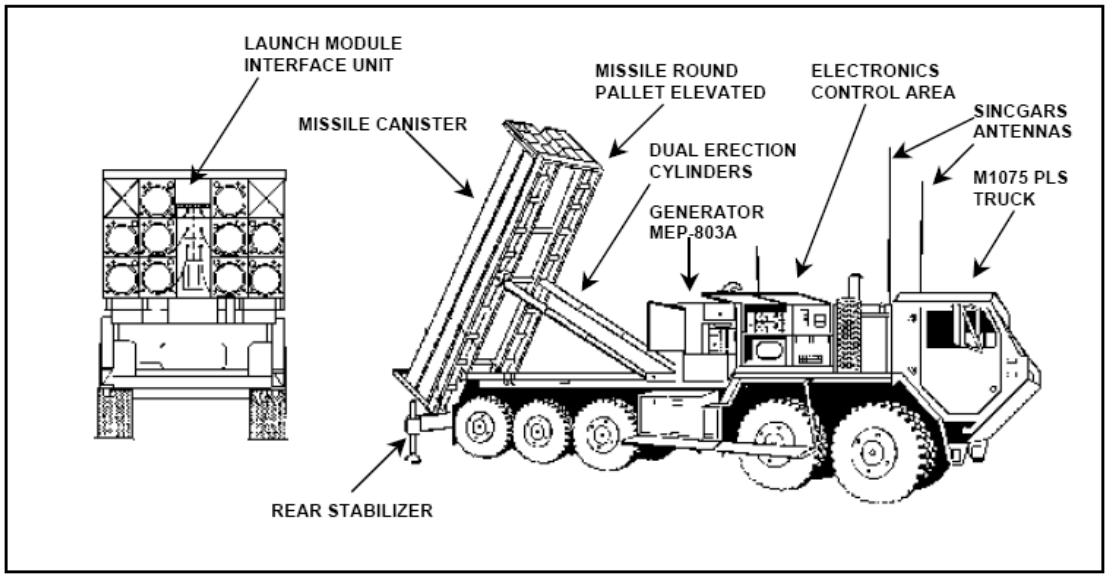

Figure 4. THAAD Launcher (From FM 3-10.11)

The Army first fielded the Patriot missile system in the 1980s as a ground-based counter to Soviet air threats. As the capability matured Patriot developed into a missile shield entity, thus elevating it from a point defense to an area defense asset. The Patriot deployment in the first Gulf War against Iraq validated to a certain extent the system's utility when it provided a missile shield of sorts as a counter to Iraqi SCUD missiles lobbed in to Israel and Saudi Arabia. This marked the first time in history that a defensive missile was employed to defeat an incoming enemy ballistic missile. More important at that time was the likely psychological effect the missile shield afforded the populace. In fact, Israel requested Patriot support shortly after the start of the war when reports of successful Patriot defense of the Saudi city of Dhahran circulated. Yet the Patriot deployment could not be considered a completely flawless success:

> Of the 90 missiles fired at Saudi Arabia and Israel, American crews determined that 47 were threatening and fired 158 Patriots to intercept them. Initial analysis showed that Patriots intercepted forty five of those forty seven SCUDs for an engagement success rate of 96 percent. The Patriots were designed to defend point targets such as airfields and ports, not entire cities. They suffered mixed results in fending off the SCUD attacks; in many cases intercepting Patriots deflected the incoming SCUDs, leaving the warheads and debris to rain down on Israeli and Saudi cities.[18]

Improvements in missile capability became the initiative for the Patriot Advanced Capabilities (PAC) development, which eventually materialized into the Patriot Advanced Capability-3 (PAC-3). PAC-3 added hit-to-kill accuracy within the terminal phase of missile flight. Patriot is the most mature component of the Ballistic Missile Defense System and fills the role of "short-range defense [of] vital civilian and military assets, defend[s] deployed troops, and provide[s] continuous air and missile defense coverage for rapidly maneuvering forces." [19]

[18] Willie Brown. NPS Master's thesis. *Analysis and Design of a Cooperative Weapon Assignment Module for Advanced Battle Manager of a Ballistic Missile Defense System*. March 2006.

[19] BMDS Booklet, MDA.

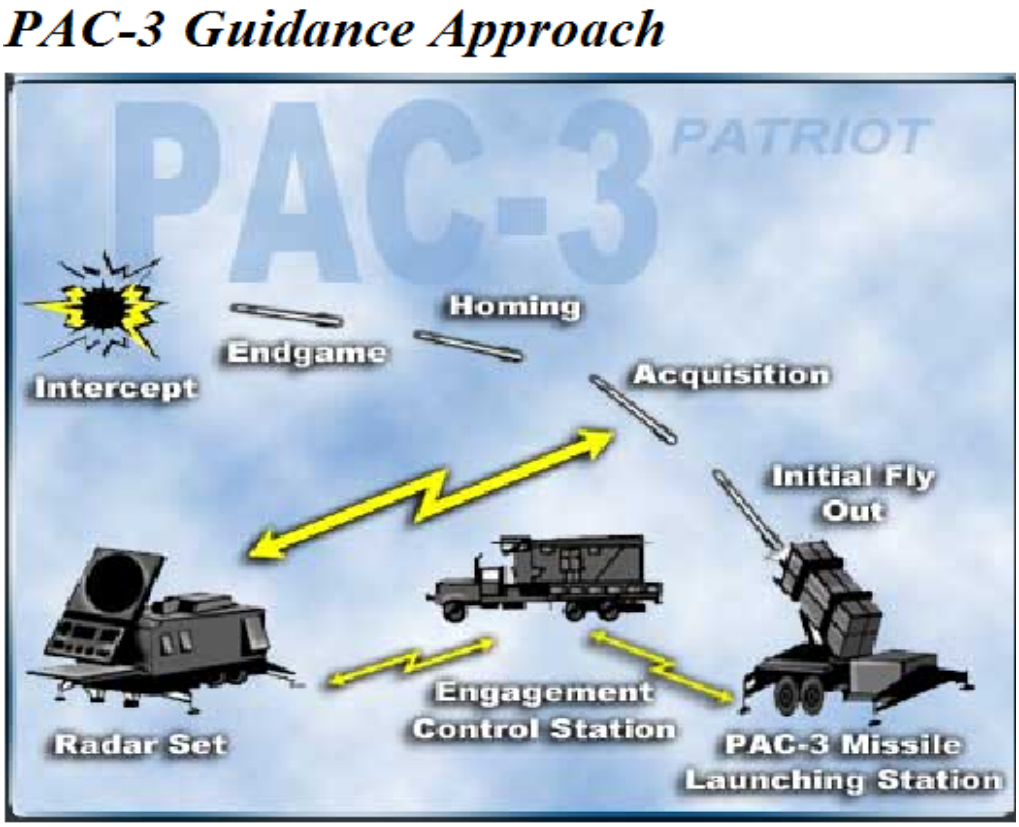

Figure 5. Patriot Advanced Capability-3 Overview
(From Missile Defense, DefenseLink)

The Patriot system typically enters into theater as a Battalion, made up of four firing Batteries and a controlling Fire Direction Center (FDC). Like the Navys' Aegis Weapon System, Patriot was designed and appropriated as a service-specific air defense system. The capability to participate in a theater-wide (now global) system did not become viable until later in the Patriot operational lifecycle.

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III. CERTIFICATION SYSTEM AND PROCESS

Joint Vision 2020 states what the Joint Chiefs expect from the Armed Services, now and in the future. Interoperability is a priority and it is in this area that the discussion of certification properly aligns. While certification is not specifically mentioned in Joint Vision 2020 there is clearly an understanding that the services must have "a suitable focus on procedural and organizational elements…decision makers at all levels must understand each other's capabilities and constraints." [20]Certification in a given area is a requirement levied by a parent service on units or activities for a variety of reasons. When an agency completes certification on a specific weapon system it indicates that the system has met a minimum agreed upon performance threshold. Similarly, when a unit certifies an individual on a piece of equipment it is an indication that the individual has demonstrated a certain level of competency in equipment operation and has, in most cases, completed formalized training associated with that equipment.

Certification of a unit or crew generally has the same meaning as the previous examples of weapon system or individual but with a somewhat different consequence. When the Navy certifies a ship in Air Defense or Ballistic Missile Defense that ship becomes available, immediately in some cases, to deploy in support of that mission. Per the Surface Force Training Manual a typical ship is expected to participate in and complete more advanced training in Strike Group training exercises prior to a deployment. However, emergent mission requirements can supercede follow-on training and a ship can deploy as certified in Ballistic Missile Defense (for example) without the benefit of the advanced training that they would normally complete. This scenario is actually not an unlikely one if one considers the Ballistic Missile Defense mission deployments as conducted by the initial Guided Missile Destroyers (DDG) in 2004-2005.

The Army certifies a Patriot Battery in a similar fashion. The Batteries conduct drills according to Field Manual (FM) 3-01.86, the Air Defense Artillery Patriot Brigade Gunnery Program, and are observed by their Battalion representatives. The Battalion then

[20] Joint Vision 2020, "Interoperability," 15.

certifies individual Batteries as 'Table VIII certified'. This certification is not the highest level of certification available but rather the minimum certification level a Battery must complete in order to be considered deployment-ready. A typical Battalion will conduct follow-on training in theater to demonstrate readiness to the area Component Commander. The parallel between the two (Navy Aegis BMD asset and Army Patriot asset) is that certification applies after completion of what amounts to a unit-level standard of training. No upper or lower bounds are attached to the certification other than a periodicity. It is assumed that the unit will conduct evolutions with a broader scope to include joint exercises but that is not a requirement for certification and thus not a requirement to deploy. This accentuates the need for: (a) a rigorous and challenging unit self-assessment program, (b) an equally rigorous assessment system as directed by the certification entity, and (c) a means to accurately document the results but more importantly a means to document the progress of the unit. Given the state of database technology and data warehousing available this last requirement, or identified need, certainly seems manageable.

Strategic Command established a program for the overall certification and qualification requirements for components within the Ballistic Missile Defense System. These requirements are divided by target audience in to four levels: Individual, Collective Unit/Crew, Staff, and Global (Figure 6).

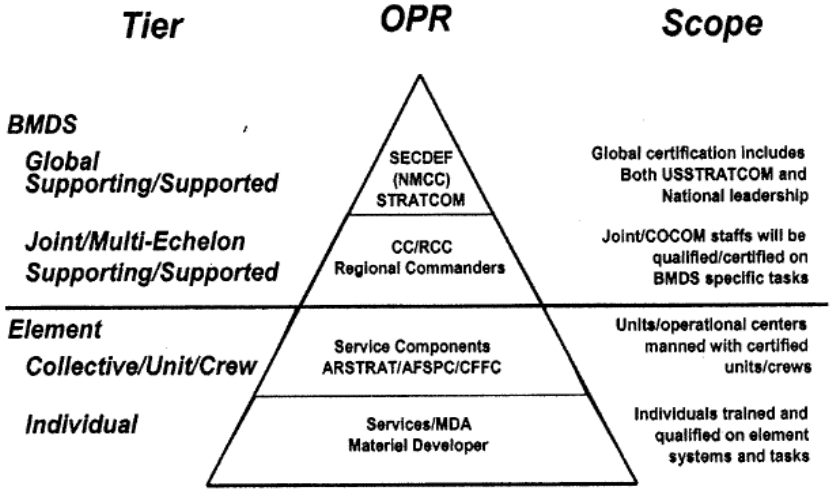

Figure 6. STRATCOM Command Certification Responsibilities (From SD 508-8)

The directive is organized to "provide initial, periodic, non-recurring(update) qualifications and certification" for all levels. It provides a description of the program but the details of execution are left to the component (service) commands. Pacific Command (PACOM) can be considered a 'Staff' level participant in this structure. In turn PACOM has a process to certify a Joint task Force (JTF) via the PACOM instruction 0029.1, Joint Task Force Certification Program, and in the context of this particular mission area would include Ballistic Missile Defense as a measurable task. This is of particular relevance as the Ballistic Missile Defense System focus has emphasized the Pacific region and a predominance of assets fall within the PACOM sphere of responsibility. The criteria for JTF certification by the Pacific Command includes:

- Competency in JTF Core Mission Joint Mission Essential Tasks (JMETs)
- Competency in assigned Mission related JMETs (BMD would be an example)
- Successful completion of a USPACOM measured certification exercise

Achievement of these and several other measures are met using three program pillars: a regimen of training, participation in a JTF command post exercise, and the assessment of JTF performance. The training and exercise observation role is staffed by Standing Joint Force Headquarters Pacific, personnel from the Joint Warfighting Center (JWFC) or specialists contracted for support. The illustrated program flow in Figure (7) captures the PACOM methodology for certification.[21]

[21] USPACOMINST 0029.1, 1 February 2006.

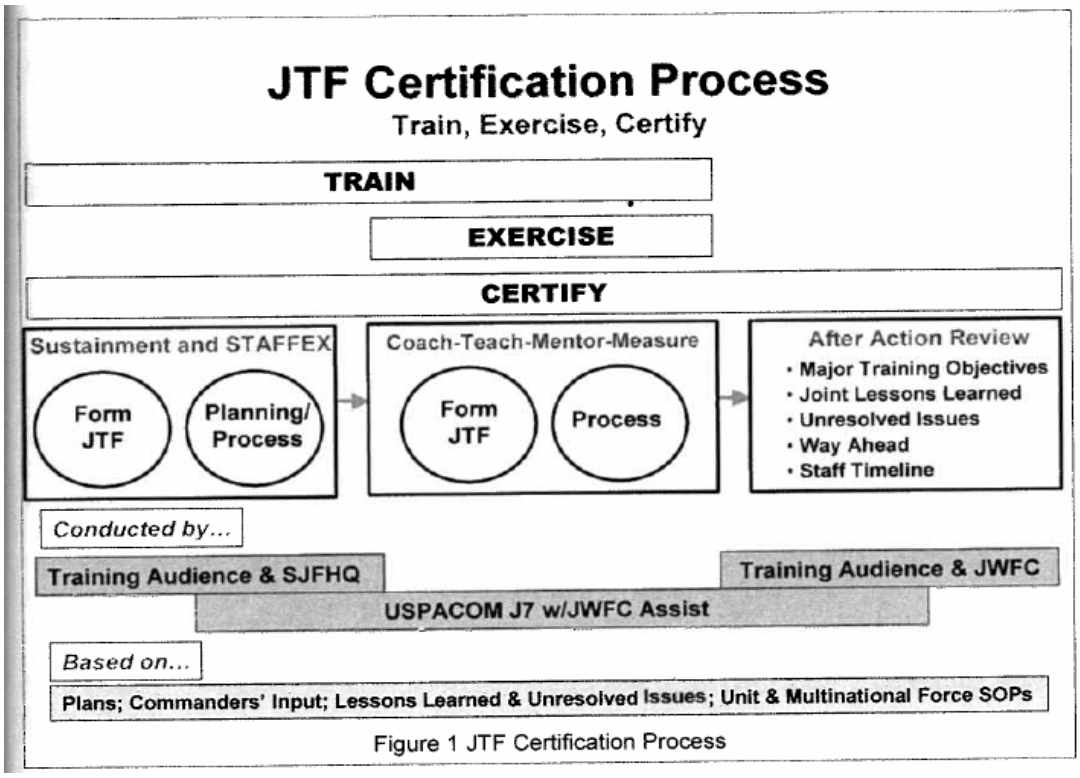

Figure 7. Generic Joint Task Force Certification Process
(From USPACOMINST 0029.1)

The next logical tier of certification in the STRATCOM tier is the unit or crew actually engaged in a Ballistic Missile Defense mission. The two elements that will be examined are from the Navy's Aegis community and the Army's Patriot community.

A. NAVY UNITS

Naval forces included 279 active ships available for tasking in a variety of mission areas. The Naval mission has evolved from coastal patrol and convoy protection in to power protection and force defense. Power projection has been the role of the aircraft carrier and amphibious assault fleet for most of the post World War II-era Navy. More recently the 'small boys', destroyers and cruisers, have played a part in power projection with the addition of the Tomahawk Land Attack Missile (TLAM). The cruiser/destroyer fleet also carried, and continuesto carry, the bulk of the force defense

missions. With the advent of advanced radar technology these units are now equipped to project force defense capability in to a much larger area as part of the Ballistic Missile Defense System.

1. AEGIS PLATFORMS

The first Aegis ship, the USS Ticonderoga, was commissioned in 1983. At present there are over seventy Aegis ships commissioned in the U.S. Navy. Nations that have made an investment in the weapon system include Japan (six ships from the Atago or Kongo class), the Republic of Korea (one King Sejong class), Norway(five Fridtjof Nansen class, Spain (five Alvaro de Bazan class) and Australia(purchased three for the upcoming Hobart class). [22] This list is not meant to imply that those nations have the capability to employ their Aegis suite in a Ballistic Missile Defense role. Aegis is a complete system that incorporates fast reaction time in an Air Defense environment but also supports many other mission areas. The Aegis Weapon System (AWS) onboard includes the following components:

- SPY-1 radar for target search and track
- Weapons Control System (WCS) for engagement management
- Fire Control System (FCS) for terminal guidance
- Vertical Launch System (VLS) for missile storage and launch
- Standard Missile (SM) variants for hard kill capability
- Operational Readiness Test System (ORTS) for diagnostics
- Aegis Display System (ADS) for command and control

[22] Wikipedia, http://en.wikipedia.org/wiki/Aegis_weapon_system#Aegis_in_other_navies.

Aegis supports the need for a flexible response to many of the theaters that the United States is interested in. The Pacific Fleet deployed the initial set of Ballistic Missile Defense certified units in 2004; this 'Limited Defensive Operation' was intended to field the system in the Sea of Japan as a means to provide some BMD capability to the area commander in the event off North Korean activity. The Navy routinely deploys entire Strike Groups to the Arabian Gulf; each Strike Group has at least one Aegis unit organic to it and in some cases three or more. As the Navy certifies more BMD assets, these ships will provide Component Commanders a maritime-based, theater missile defense capability as well as a component within the overall Global Missile Defense System.

a. Guided Missile Cruisers

There are twenty-two Ticonderoga class Cruisers in commission as of 2008 and no plans to build any more. Three of the twenty-two have had the upgrade for the Ballistic Missile Defense mission and have been certified to conduct. The Navy has committed to extend the life cycle of many of these warships via 'Cruiser Conversion', a modernization plan that will update many onboard components including the Aegis Weapon System. Cruisers are "multi-mission (Air Warfare, Undersea Warfare, Naval Surface Fire Support and Surface Warfare) surface combatants capable of supporting carrier battle groups, amphibious forces, or of operating independently and as flagships of surface action groups."[23] Prior to deploying a typical Cruiser must certify in twenty separate mission areas.

A Cruiser is considered a Major Command, on par with a Destroyer Squadron in the surface community, and is therefore an O-6 (Navy Captain) command. Accordingly, many Cruisers also deploy as the primary Maritime Air Defense Commander in a Strike Group, responsible for the air defense coordination of a given area around the Strike Group. There are also occasions when a Cruiser is assigned other Warfare Commander (Surface Warfare, Undersea Warfare) duties in a primary role.

[23] "The U.S. Navy: Our Ships." http://www.navy.mil/navydata.

b. Guided Missile Destroyers

There are 57 Arleigh Burke class Destroyers in commission as of 2008 and at least four more have funds appropriated for construction. These Destroyers fulfill numerous roles within the current surface force. Their decreased draft allows for a more littoral presence than the Ticonderoga class ships. Note that they also are very much a multi-mission platform and deploy much like a Cruiser. A typical Destroyer must certify in twenty separate mission areas. Fourteen destroyers have been outfitted for the Ballistic Missile Defense mission to date and are certified to conduct.

Destroyers are commanded at the O-5 (Navy Commander) level. It is not the norm for a given Strike Group to utilize a Destroyer as a primary Warfare Commander.

B. TYPE COMMANDER CERTIFICATION

The Navy can basically be divided in to two regions, Pacific and Atlantic (PACFLT, LANTFLT). A 'Type Commander' is associated with each force category to include Surface Forces, Air Forces and Submarine Forces to name the more influential Type Commanders. The Type Commanders are responsible for the training, readiness and manning their force structure so as to provide Operational level commanders resources for missions. In the arena of Ballistic Missile Defense the cognizant Type Commander is Commander, Naval Surface Forces (SURFOR). SURFOR "equips its forces with the necessary training, tools, maintenance and material to successfully accomplish their mission—across the entire spectrum of warfare operations."[24] An influential mechanism to accomplish that task is via the Type Commander certification process. Succinctly, the Type Commander sets forth minimum certification requirements in every pertinent warfare area per specific ship class. These requirements are defined in the Surface Force Training Manual (SFTM).

[24] "CNSP Mission Statement."http://www.surfpac.navy.mil/site%20pages/mission.aspx.

1. Surface Force Training Manual

The Surface Force Training Manual provides the framework for meeting the stated requirement of continuous readiness. Continuous readiness is maintained by adhering to the requirements of the SFTM throughout a given ships' operational schedule. A typical employment schedule includes a Unit Level phase, a Surge Ready phase, Sustainment, Deployment, and post-Deployment periods. The certification requirements are typically met and demonstrated during the Unit Level phase. A critical idea expressed in the SFTM is that ship crews must demonstrate the ability to train themselves in addition to meeting the certification requirements. "The goal of Unit Level Phase training is that the ship's training teams be able to effectively train and assess themselves and the ship to be certified in those ….primary mission areas."[25] The Fleet Response Training Plan (FRTP) encompasses the major readiness phases and is designed to develop and maintain Strike Group proficiency. Per the SFTM, the ability of a ship to maintain continuous readiness, as specifically defined by warfare area within the document, is the 'key enabler' for FRTP functionality.

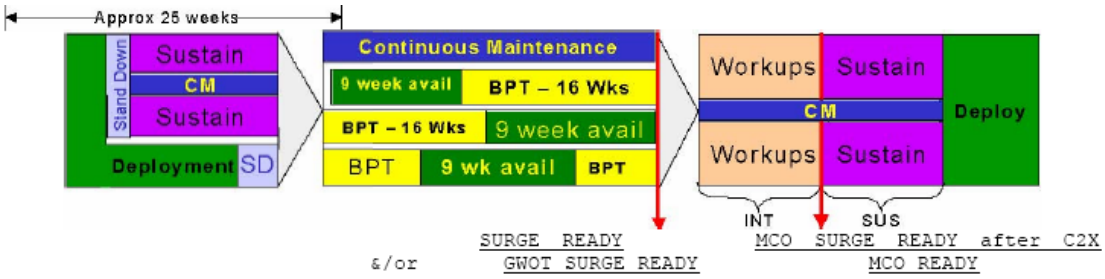

Figure 8. Fleet Response Training Plan (From CNSFINST 3502.1C)

The Surface Force Type Commander employs two 'enabling data engines' in the form of Training and Operational Readiness Information Service (TORIS) and Training Figure of Merit (TFOM) to report ship progress, capture data, compare ship class trends, and achieve training and certification process efficiency. TORIS is the 'single authoritative database/hub for all proficiency efficiency metrics….(it is) a web-based data-engine, consisting of various applications used to assess, train and certify ships.'

[25] Surface Force Training Manual.

TFOM is used as a lens that displays current status of a given mission area. It is based on four generic areas of a mission area: the 'pillars' of Proficiency, Personnel, Management, and Material. These pillars are the basis for the Continuous Certification Requirements (CCRs), those things that a crew must meet and demonstrate enroute to certification. Conceptually, TORIS is the holder of all pertinent data points associated with a mission area and TFOM is the progress report on that mission area. This information is valuable to the crew attempting to certify but also proves valuable for decision makers up the chain of command when analyzing readiness trends, best practices, and validating requirements.

The following describes the Continuous Certification Requirements employed by the Surface Force commander to assess and certify ships in Ballistic Missile Defense per Tab U of the Surface Force Training Manual.

COMNAVSURFORINST 3502.1C

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AIR SUPERIORITY
TAB U
BALLISTIC MISSILE DEFENSE (BMD) CERTIFICATION CRITERIA

1. This certification applies to BMD configured CG/DDG ships (Level I (Long Range Surveillance and Track (LRS&T) and Level II (Ballistic Missile Defense Engagement capability (BMD)).

2. **Ballistic Missile Defense References**.

a. Combat Systems Techniques and Procedures (Ship Class)
b. JANAP-119 (L) (Brevity Code Words)
c. CJCSM 6120.01C w/ch-1(series) Joint Multi-TADIL Operating Procedures
d. Understanding LINK 16 Guidebook and Procedures for LINK 16
e. NAVY-WIDE OPTASK COMMS
f. NAVY-WIDE OPTASK LINK
g. TADIL Consolidated Navy Training System Plan (N6-NTSP-E-70-0105)
h. AEGIS Ballistic Missile Defense Element Employment Guide
i. NAVY-WIDE OPTASK AD
j. NAVY-WIDE OPTASK BMD (when promulgated)
k. SWDG TACMEMO - SWDG TM 3-01.5-04
l. Ballistic Missile Defense Operational Employment Guide
m. COMNAVSURFORINST 8820.2 (series) Long Range Surveillance and Track/Ballistic Missile Defense Engagement Qualification/Certification Program

3. **Continuous Certification Requirements (CCRs)**. A ship must satisfy the following CCRs at all times.

	Proficiency CCRs	Methodology/Criteria
1	Training Team Proficiency	Requires proficiency in the Combat Systems Training Team to Plan, Brief, Execute, and Debrief properly. The following Training Objective will be used: - Establish Training Teams - Exercise Planning, Preparation for Mission/Team Focused Training Event(s) - Brief Mission/Team Focused Training Event(s). - Execute Mission/Team Focused Training Event(s). - Debrief Mission/Team Focused Training Event(s).
2	Demonstrate proficiency in BMD LRS&T and Engagement Scenario	Requires proficiency by two (2) qualified Level I/II* watchteams and one (1) qualified CSTT Level I/II* watchteam during a complex scenario. Scenario will demonstrate execution of CO's Battle Orders and will include a challenging, tactical, complex, multi-axis threat with INT, EW, CRY cueing.
3	Demonstrate proficiency in IBS-I	Requires proficiency by two (2) IBSSO certified IBS-I (Producer) watchteams and an IBSSO certified CSTT member to achieve and sustain IBS-I. Refer to http://www.atg.surfor.navy.mil/ for EO's, TO's, MOP's.

*** BMD Engagement capable platforms only.**

	Personnel CCRs	Methodology/Criteria
1	Meet 80% required schools	At least 80% of required NTMPS schools onboard and confirmed quotas for the unfilled requirements. Ships will also present a long-range schools management plan projecting 4 quarters.
2	PQS qualified Training Team capable of training all watch teams	All CSTT members must be qualified for the position they are observing with sufficient members to observe all applicable watchstations. CSTT must be designated in writing by the Commanding Officer.
3	PQS qualified watchteams	Two PQS qualified Level I/II* watch teams. One PQS qualified Level I/II* CSTT watch team.

* BMD Engagement capable platforms only.

	Management CCRs	Methodology/Criteria
1	Completion of ASA Check sheets	At least 80% of all items met with full compliance and a plan to correct all deficiencies
2	Current, signed Battle Orders	Watchteams will be assessed on their ability to fight IAW the ship's Battle Orders, signed by the current Commanding Officer.
3	Watchteam Replacement Plan (WTRP)	Effective WTRP for two Level I/II* watchteams, one CSTT Level I/II* watchteam, and the Combat System Training Team. WTRP will project out four quarters at a minimum.

*** BMD Engagement capable platforms only.**

	Material CCRs	Methodology/Criteria
1	Demonstrate operational Combat Systems suite	Ships will demonstrate that the Combat Systems suite is operating within design specifications. Ship must satisfactorily complete an ATG/ISIC observed OCSOT, DSOT, SOT, and PSOT within the past three months prior to or in conjunction with ULTRA Cert.
2	Successfully receive LRS&T/*BMD Engagement mission tasking and warnings via portable training system.	Ship will demonstrate proficiency by conducting complex scenarios utilizing (ASTATS) portable training system or approved BMD embedded training devices.

*BMD Engagement capable platforms only.

Figure 9. Tab U; CG and DDG BMD Certification Requirements (From CNSFINST 3502.1C)

The Type Commanders' Executive Agent for conducting training and assessments, the Afloat Training Group (ATG), works with the appropriate scheduling agencies to allot training periods for each ship. A concerted effort has been made to streamline the process by providing the bulk of re-certifications to occur around the same time (per ship) and by putting the onus on the ship to maintain the Continuous Certification Requirements. This is intended to have the effect of freeing up more availability time so that ships can meet operational tasking.

a. Continuous Certification Requirements

As illustrated in Figure (9) the requirements are divided in to four basic areas or 'pillars':

1. Proficiency
2. Personnel
3. Management
4. Material

Proficiency is measured by assessing the ships' Training Teams ability to train itself as well as their ability to train the various positions up to a defined standard (defined by objective criteria in TORIS). The vehicle to accomplish this is via a series of increasingly complex training scenarios. Additionally, select individuals must demonstrate proficiency in utilizing the Joint Tactical Terminal to receive electronic intelligence via the Integrated Broadcast Service for cuing.

Personnel requirements include a fully qualified training team, fully qualified watch teams, and the ship must have graduates from at least 80% of the required schools that pertain to Ballistic Missile Defense. Fully qualified in this case means all members of a given team are qualified in the station that they are manning or assessing. The school requirements are defined by warfare area in a comprehensive decision support system for management at all echelons known as Navy Training Master Planning System (NTMPS).

Management requirements are met by meeting three criteria: the current Commanding Officer must have signed in to effect his/her Battle Orders, the ship must have a comprehensive replacement plan documented for the upcoming year, and the ship must have documented their status on Afloat Self-Assessment sheets as provided by the Afloat Training Groups.

Finally, in the **Material** section the ship must demonstrate equipment readiness by completing, or recently completed, a system operability test and utilizing embedded training devices where applicable. This last requirement is not yet as mature in Ballistic Missile Defense as it is in other warfare areas but there has been an effort within the training communities to provide a robust training product to the ships.

All of the above requirements are demonstrated to, and validated by, the Type Commanders' executive agent in this arena, the Afloat Training Groups (ATG),

collectively known as the Afloat Training Organization. Additionally, the immediate operational commander of the ship (or ISIC, Immediate Superior in Charge) will have a staff representative onboard for on-site verification as well. Upon certification a ship will typically conduct a follow-on, certification-like training event a few months later to ensure that the crew is in fact sustaining those skills demonstrated and that the Continuous Certification Requirements are to date.

b. TORIS Data and NMETL Relationship

The specific events demonstrated by a ship, and captured as a data point in TORIS, are the granular components of the overarching Universal Naval Task List (UNTL). This Task List is a common reference for commanders at the joint level for the reporting of joint training and readiness. The tasks are used to document war fighting requirements as 'Mission Essential Tasks' (METs). In turn the UNTL is linked to the Universal Joint Task List (UJTL); in all, both of these lists exist for the 'planning, conducting, assessing and evaluating joint and Service training'[26]. The overall UNTL decomposes in to various stages of granularity but it is critical to note that the most detailed level pertaining to specific mission accomplishment ends with the Naval Mission Essential Task List (NMETL). By definition, development of the Naval Tasks was conducted using the following guidelines:

- Tasks describe an activity outside the command
- Tasks describe a discrete event
- Tasks do not define who
- Tasks do not define how
- Tasks do not discuss a specific piece of equipment
- Tasks do not describe environmental issues
- Tasks do not duplicate an existing task

Further, tasks do not specify means (type of unit, system, etc.) and do not include conditions. The focus is strictly on activities performed. There is an established standard for each task, described as the 'minimum acceptable proficiency required' in the

[26] Universal Naval Task List; OPNAVINST 3500.38B/MCO3500.26/USCG COMDTINST 3500.1B.

demonstration of task performance. Figure (10) illustrates a task linked to missile defense with an associated criterion for assessment:

NTA 3.2.7 Intercept, Engage, and Neutralize Enemy Aircraft and Missile Targets (Defensive Counter Air)
To intercept, engage, neutralize, or destroy enemy aircraft and missiles in flight. Includes disruption of the enemy's theater missile (ballistic missiles, air-to-surface missiles, and air, land and sea-launched cruise missiles) operations through an appropriate mix of mutually supportive passive missile defense, active missile defense, attack operations, combat air patrol (CAP), and supporting C4I measures. **(JP 1, 3-0, 3-01 Series, 3–01.5, NDP 1, NWP 3 Series)**

M1	Number	COA denied to enemy due to friendly interdiction.
M2	Percent	Of enemy targets engaged.
M3	Percent	Of targets attacked with desired effects.

Figure 10. BMD-related Naval Task (From OPNAVINST 3500.38B)

Based on the above criteria a given task is not attributable to a specific crew, team or individual. The system employed by the agents of the Surface Force Type Commander provides a much greater degree of detail so that, at the unit level, commanders can assess a given crew. Appendix A is a list of data points captured by the assessment team during Ballistic Missile Defense certification.

The Navy employs a Web-based SIPRNET client known as Navy Training Information Management System (NTIMS) to 'build, store, and apply NMETLS…and training resource and requirement models'. The developers of TORIS and TFOM are working towards a fully automated data feed to transfer the granular training information within their system to NTIMS via Extensible Markup Language (XML) Web Services.[27]

c. 8820.2 Series

In addition to the Training Manual instruction the Surface Force Type Commander also has a separate instruction pertinent to the Ballistic Missile Defense mission. The SURFOR Instruction 8820.2 series, Ballistic Missile Defense Long Range Surveillance and Track (LRS&T)/Engagement Qualification/Certification Program, specifies "procedures for certification and tactical qualification" of Aegis ships

[27] ATG Brief, Training Summit.

possessing the BMD upgrade. [28] In general, the tactical qualification requirements in the 8820 parallel the tasks in Tab U proficiency measures of the SFTM. The 8820 also levies a Material and Safety certification on the ship. In fact, most of the instruction is devoted to the specifics of the Material/Safety aspect. Chronologically, the 8820.2 series was released to the fleet coincident with the initial Aegis BMD installations, before a BMD Tab had been added to the Training Manual instruction.

d. SORTS

The traditional means by which any Navy unit reports status per mission area is via the Status of Resources and Training System (SORTS). There is very nearly a one to one parallel in the 'Mission Areas' in SORTS to the warfare certifications a ship meets in the Surface Force Training Manual. One drawback to SORTS is that it captures deficiencies but not necessarily proficiencies and that it is a snapshot of that units' readiness at a moment in time. That readiness is assigned from one to five states (M1 through M5) and there is no mechanism available to the commander to compare the true readiness level between two or more ships reporting like states (M1 for instance). The Training Figure of Merit system allows the commander to 'drill down' and view specific areas of increasing or declining proficiency onboard a given ship.

2. Sustainment Training

As stated in the Surface Force Training Manual, ships are intended to complete 'unit level' training coincident with their appropriate certifications and move on to intermediate or advanced phases. This involves various live and synthetic exercises with their assigned Strike Group. The Numbered Fleet Commanders (Third, Seventh and Second Fleets respectively in this case) are responsible for this level of training. The Ballistic Missile Defense Exercise (BMDEX) is the vehicle to accomplish Sustainment training for units or Strike Groups. The BMDEX utilizes a ship's embedded training

[28] CNSFINST 8820.2.

capability, a portable training device or a distributed training scenario employing various degrees of fidelity. This exercise is a quarterly requirement for units and is part of the Training Figure of Merit calculation.

C. AIR DEFENSE ARTILLERY

The Army has had a Regiment Artillery in service since 1776. The Air Defense Artillery was established as a branch of the Army in 1968 although air defense regiments were constituted during World War II for combat support. These commands evolved in to iterations of the Army Air and Missile Defense Command (AAMDC). The AAMDC is "the Army's combat organization for planning, coordinating, integrating, and executing (missile defense) operations."[29]Air Defense Artillery is not exclusive to the Patriot community as other Battalions also report to an ADA Brigade (the Avenger community for example). A Patriot Battery is just one component within the Army's Air and Missile Defense Command construct. A condensed chain of command hierarchy starts with a Battery platoon to a Patriot Battalion and then ends (for the sake of this discussion) with an Air Defense Artillery Brigade.

1. Patriot

The combat element of the Patriot weapon system is the Firing Battery (FB). The system will normally fight as a Battalion with a complement of four batteries and a Fire Direction Center (FDC) for localized command and control. The Firing Battery (FB) of the Patriot weapons system includes the following major components (Figure 11):

[29] FM 100-12, Army Theater Missile Defense Operation.

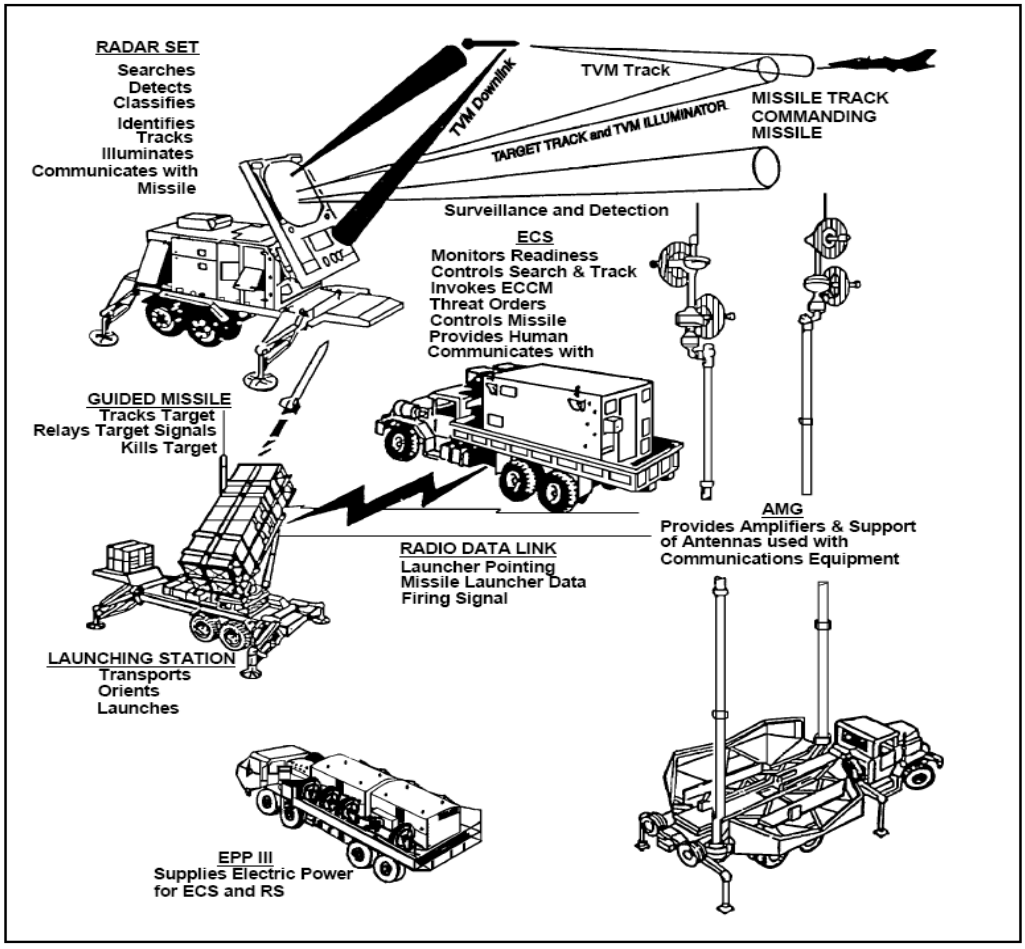

Figure 11. Patriot Firing Unit Components (From FM 3-01.11)

- Radar Set (RS), a phased array multi-function radar for search and track
- Engagement Control Station (ECS) for operational control of the Battery
- Launching Station (LS) transports and launches the missiles
- Antenna Mast Group (AMG) provides antenna and amplifier systems for communications
- Electrical Power Unit (EPU) or Plant (EPP) provides primary power
- The Battery Command Post (BCP) is the weapon system interface to other information systems
- The Guided Missile (GM) includes the canister which also functions as launch tube and shipping/storage container

The Battalion Headquarters and Headquarters Battery (HHB) exercises control over the Batteries via the Information and Coordination Central (ICC), a vehicle that is

equipped with track management, communications, and command and control capability. A Battalion is commanded by a Lieutenant Colonel (LTC), an O-5 with an Air Defense background.

At present, there are thirteen active Patriot Battalions in the Air Defense Artillery community. The weapon system has seen considerable service in Operations Desert Storm and Iraqi Freedom but has also been deployed to the Korean peninsula and to the European theater in support of North Atlantic Treaty Organization exercises. Table (2) summarizes the U.S. Army Patriot battalions and the Brigade they report to.

Battalion	Base	Brigade Commander
2d BN, 43d ADA	CENTCOM	11th BDE
1st BN, 43d ADA	FT Bliss, TX	11th BDE
3d BN, 43d ADA	FT Bliss, TX	11th BDE
5th BN, 52d ADA	FT Bliss, TX	11th BDE
6th BN, 52d ADA	FT Sill, OK	31st BDE
3d BN, 2d ADA	Osan AFB, ROK	35th BDE
1st BN, 44th ADA	Osan AFB, ROK	35th BDE
2d BN, 1st ADA	FT Hood, TX	69th BDE
4th BN, 5th ADA	FT Hood, TX	69th BDE
1st BN, 7th ADA	FT Bragg, NC	108th BDE
3d BN, 4th ADA	FT Bragg, NC	108th BDE
1st BN, 1st ADA	Kadena AFB, Okinawa	94th AAMDC
5th BN, 7th ADA	Rhine Barracks, GE	357th AMD-D

Table 2. U.S. Army Patriot Battalions

Other nations that have made an investment in the Patriot weapon system include Japan, Germany, Saudi Arabia, Kuwait, Israel, Greece, Taiwan, and the Netherlands.[30] The Army and the Missile Defense Agency are integrating the advanced capability version of Patriot with the developing Medium Extended Air Defense System (MEADS), a cooperative venture between the United States, Italy and Germany to develop a mobile system that is netted and distributed.

[30] "Patriot Missile System." http://www.espionageinfo.com/Pa-Po/Patriot-Missile-System.html.

a. PAC-3

The modifications to upgrade the Patriot weapon system were acquired in a series of configurations with the generic title of Patriot Advanced Capability 3 (PAC-3). The PAC-3 Configuration 1 addition in 1995 upgraded the Engagement Control Station and Information Coordination Central, added a pulse Doppler processor for radar performance enhancement, and included embedded data-recording equipment. One year later the PAC-3 Configuration 2 added the Joint Tactical Information Distribution System (JTIDS) for data exchange with joint forces and software upgrades that improved radar performance, system detection, identification, and engagement. The PAC-3 Configuration 3 added a program that "significantly improved radar range performance to discriminate and identify a tactical ballistic missile warhead from other target debris or objects." In 2001 the delivery of a lethality enhancer in the form of hit-to-kill technology made the Patriot PAC-3 missile a significant element in the lower tier BMD architecture.[31]

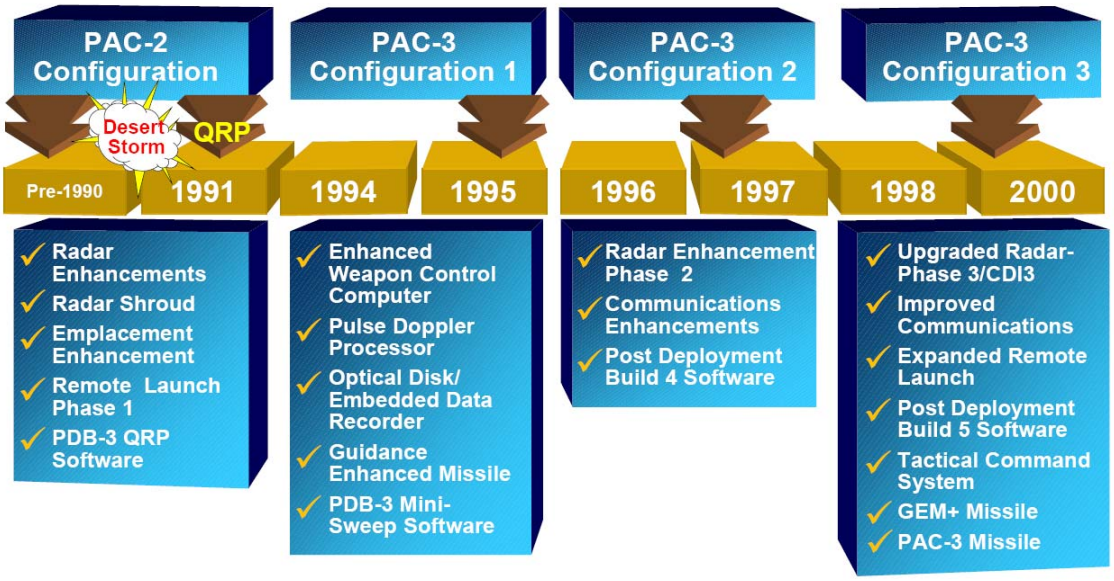

Figure 12. Patriot Configuration Evolution (From www.raytheon.com)

[31] "Raytheon Company Patriot Products."www.raytheon.com/products/patriot.

D. BRIGADE CERTIFICATION PROGRAM

The certification of Patriot Batteries and Battalions is conducted under the guidance of Army Field Manual 3-01.86, the Air Defense Artillery Patriot Brigade Gunnery Program. The proponent of the program is the Army Air Defense Artillery School (AADASCH) under the overall auspices of the Army Training and Doctrine Command (TRADOC). TRADOC supports unit training, develops doctrine, establishes standards in addition to the recruitment and training of soldiers. [32]

The program is based on a series of gunnery tables outlined in FM 3-01.86 and applies a frequency requirement to each certification level. Decertification criteria are also detailed in the Field Manual. It is designed to develop and then test the proficiency of the individual, crew, and Battery in a sequential, performance-oriented training environment.

1. FM 3-01.86

The purpose of the gunnery tables is to "train individuals to perform as crew members" [33] at the Basic level. Following successful completion of the Basic Gunnery Tables, I through IV, individuals receive a Basic certification as a qualified crew member. This is achieved via hands-in training, individual instruction and successful completion of practical and written exercises. The initial qualification must be achieved within ninety days of reporting to the unit. Evaluation is conducted at the Battery level with the examinations typically administered by the Brigade Electronic Missile Maintenance Officer (EMMO).

The Intermediate and Advanced Gunnery Tables, also included in FM 3-01.86, are the responsibility of the parent Brigade. It is typical for the Brigade to employ evaluators from sister Battalions, when available, for evaluation of the various crew stations. The actual certification events are Table VIII and Table XII. The gunnery tables

[32] "About TRADOC."http://www.tradoc.army.mil/about.htm.

[33] FM 3-01.86.

preceding are preparatory exercises that the Batteries (and/or Battalions) train to prior to requesting the graded certification event (Figure 13).

Level	TABLE	SUBJECT MATTER
Basic Gunnery Tables	I II III IV	System Skills Ready for Action Drills Battle Drills System Capabilities / Tactics Certification
Intermediate Gunnery Tables	V VI VII VIII	Air Defense Operations / Missile Reload Day & NBC March Order/Emplacement Practice Table V and VI Certification
Advanced Gunnery Tables	IX X XI XII	Air Defense Operations / Missile Reload Night & NBC March Order/Emplacement Practice Table IX and X Certification

Figure 13. Patriot Gunnery Tables (From FM 3-01.86)

a. Table VIII

A Table VIII certification is an Intermediate certification used to train Patriot crews "to march order, emplace, initialize, and conduct air battle operations in a 'Battery Collective Environment' during daylight hours in varying NBC environments."[34] It is typically conducted in conjunction with a Field Training Exercise (FTX). Crews are required to be Table VIII certified within 180 days of arrival to the unit and once every 180 days thereafter until the Advanced Gunnery Table certification is achieved. The scenarios used to accomplish the crew and Battery tables are categorized as basic, intermediate or advanced and are part of a library of tailorable scenarios titled Reticle Aim Levels (RAL) one through 17. Intermediate RALs, six through eleven, are 45 to 60 minutes in duration, with minimum raid sizes, hostile air tracks, Theater Ballistic Missile raids, and equipment casualties. There are also timed requirements for a system march, emplacement and re-join. Crews 'train up' to the Table VIII certification by utilizing a RAL 10 scenario, which also includes a Battalion 'netted', or shared, scenario for track exchange with other units and the ICC.

[34] FM 3-01.86.

A Patriot Firing Unit is required to maintain the following minimum crew levels for the Intermediate or Advanced Gunnery Table:

- Two Engagement Control Station (ECS) crews
- One Radar Set (RS) crew
- One Electrical Power Plant (EPP) crew
- One Antenna Mast Group (AMG) crew
- One Command Post (CP) crew
- One RSOP(reconnaissance) team
- Five Launcher crews
- Two Guided Missile Transport(GMT)/Forklift Missile reload teams

Additionally, the Battalion Headquarters Batteries must maintain:

- Two Information and Coordination Central (ICC) crews
- One AMG crew
- Two Communications Relay Group (CRG) crews
- One RSOP team

De-certification will result from a failure to meet the minimum crew certifications described above and/or if an equipment crew fails an evaluation.

b. Table XII

A Table XII certification is an Advanced Gunnery Table certification conducted during night hours but with much of the same criteria as a Table VIII. Battalions utilize the more advanced RAL scenarios (11-17) for these events. A Table XII certification is annual crew requirement. The Table VIII minimum crew levels also apply to the Advanced certification.

c. Universal Task List

The Army Universal Task List provides a "standard, doctrinal foundation and catalogue of the Army's tactical collective tasks" [35] that apply to the tactical level of war. It articulates the Army task but does not describe what constitutes success. It does

[35] FM 7-15.

provide measures of performance for use in development of task standards. A complete mission statement from the assessing authority is used to specify type of unit for task accomplishment and when/how the task will be performed. Army Task 4.0 (ART 4.0) describes the battle operating system in Air Defense, to include force protection from ballistic missiles.

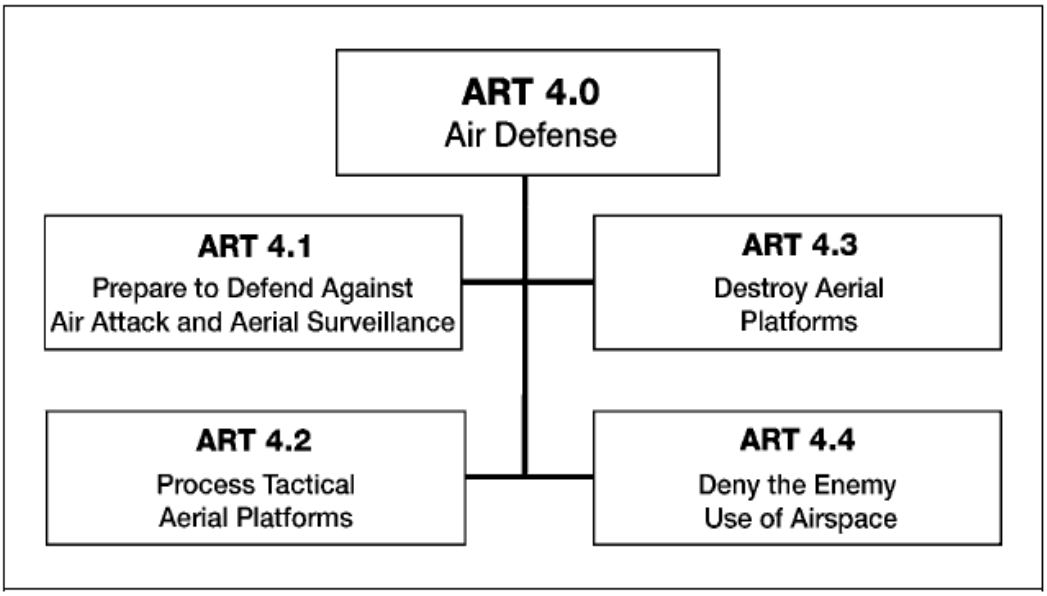

Figure 14. Air Defense Task(From FM 7-15)

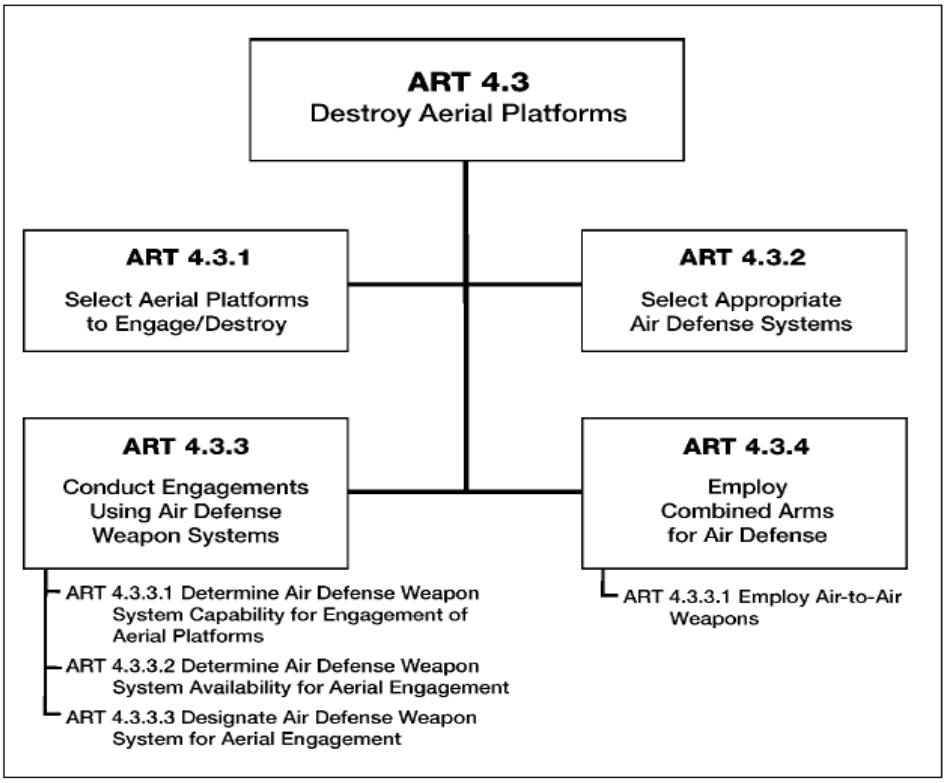

Figure 15. Air Defense sub-tasks(From FM 7-15)

Progressing from the universal task to the more specific task, in this case involving the conduct of engagements (Figure 15), the Task List provides the performance measure and the scale for measurement. Scale in this instance is binary (Yes/No) or quantifiable (time, percentage). Table (3) refers:

ART 4.3.3 Conduct Engagements Using Air Defense Weapon System		
No.	Scale	Measure
1	Yes/No	Friendly course of action must change as a result of enemy air attack.
2	Yes/No	Were air defense weapons used in accordance with established rules of engagement?
3	Time	To warn dedicated air defense units after indication of inbound enemy aerial platforms.
4	Time	For air defense weapon system to acquire, track, and engage as necessary a specific aerial platform once assigned responsibility for the engagement of that specific aerial platform.
5	Time	To determine weapons control status.
6	Time	For air defense weapon system to recycle/reload so that it Is capable of engaging another aerial platform.
7	Percent	Of enemy aerial platforms able to penetrate air defense network to deliver ordnance/accomplish mission.
8	Percent	Of all air defense systems positioned to engage the enemy aerial platform.
9	Percent	Of friendly courses of action that must be changed because of enemy attack.
10	Percent	Of enemy aerial platforms engaged that are destroyed by each air defense weapon system.
11	Percent	Of friendly casualties attributed to enemy aerial platforms.
12	Percent	Of enemy engaged aerial platforms deterred from delivering their ordnance on target.
13	Percent	Of available air defense systems directed against declared hostile aerial platforms.
14	Number	Of destroyed enemy aerial platforms by air defense weapon system.

Table 3. Air Defense Engagement Task Measures

Commanders utilize this Task List to develop the Mission Essential Task List (METL) applicable to their unit and mission. The Gunnery Tables in FM 3-01.86 serve as the decomposition of specific METL sub-tasks to a more granular level.

2. Proficiency Training

The Patriot community uses institutional and embedded training devices to develop and maintain proficiency for tasks and sub-tasks. The Patriot Conduct of Fire Trainer (PCOFT) is a computer-driven device that runs Patriot tactical software for console reproductions of the ECS and ICC. The Embedded Trainers (ET) are "troop proficiency trainers with software programs that are built in to the tactical system and provide training in simulated AD battle scenarios…(crew members) receive sustainment training and collective training." [36] Other devices are used for maintenance instruction, missile handling, casualty response, and electronics operation.

[36] FM 3-01.11.

IV. CORPORATE MEMORY

The challenges faced by units and organizations in the missile defense arena are similar to challenges posed to organizations in the business arena. There are two fundamental issues that align closely with both examples. There is a need to measure an output a need to capture those measurements. Chapter III described the certification process in terms of what was being measured. Typically the measurement was the result of some discrete event pertaining to a missile defense exercise. This chapter will examine the methodology used to capture that measurement.

It would be faulty to assume that because two units certify using the same process that they are in fact inter-changeable. The truth is that they are equally certified, and therefore equally 'ready' in an official sense for reporting purposes. However, it is very likely that one unit is in fact more 'ready' based on the strengths of individuals within that unit. A plausible scenario in one example assumes a unit that has a fire control maintainer who has deployed with four years experience is probably more ready, at that position at least, than a unit with a first deployment maintainer with less than a year of experience.

The above example suggests that the current system employed in the certification process should have the ability to measure and store granular information about individual performance within the crew. It does not suggest that a unit in the above example should not achieve certification based on crew turnover. Turnover is inevitable and presents an opportunity to train and advance newer personnel as well as a unit opportunity to advance the processes, systems and approaches embedded within that units' corporate memory. Therefore, the management of intangible assets such as knowledge can add to a more robust understanding and indication of true readiness.

A. KNOWLEDGE AS AN ASSET

Corporate memory can loosely be defined as "the body of data, information and knowledge relevant to an individual organization's existence."[37] This definition may give a false indication that data, information and knowledge are synonymous. Knowledge tends to have various definitions or descriptions, including the following examples[38]:

- Knowledge is organized information applicable to problem solving
- Knowledge is information that has been organized and analyzed to make it understandable and applicable to problem solving or decision making
- Knowledge is reasoning about information and data to actively enable performance, problem-solving, decision-making, learning and teaching

Corporate memory and, by extension, organizational knowledge can also be defined using similar language.

- Organizational knowledge is the collective sum of human-centered assets, intellectual property, infrastructure assets, and market assets.
- Organizational knowledge is processed information embedded in routines and processes that enable action.

Much research has been done in the area of knowledge management. For the purposes of this study the focus is to highlight that organizational knowledge has value. This value is more difficult to quantify when compared to hardware but is as important and thus needs to be preserved so that the organization can continue to derive benefit from it. The missile defense community is relatively new when viewed as a Joint group; whatever knowledge resident within the community can be of extreme importance and requires not only preservation but also analysis. This very much applies down to the unit level where the bulk of the actual work of missile defense is conducted.

B. PERFORMANCE MEASUREMENT

There are many approaches regarding how to measure performance. Organizations must employ some form of internal and/or external process measurement

[37] "Organizational memory." http://en.wikipedia.org/wiki/Organizational_memory.

[38] Jay Liebowitz. Knowledge Management Handbook. " The Current State of Knowledge Management."

method in order to remain competitive. In 1995 the Department of Energy published a performance-based handbook titled “How to Measure Performance: A Handbook of Techniques and Tools.” This handbook has generic examples of different methods that can be used as a starting point before examining the processes used by the two communities in question. The one example that best aligns with the military processes was designed by the Department of Energy Nevada Family Quality Forum, labeled simply the Performance Measurement Process. This process involves producers, customers, feedback mechanisms, and output measurement. Figure 16 illustrates a high level view of the overall process.

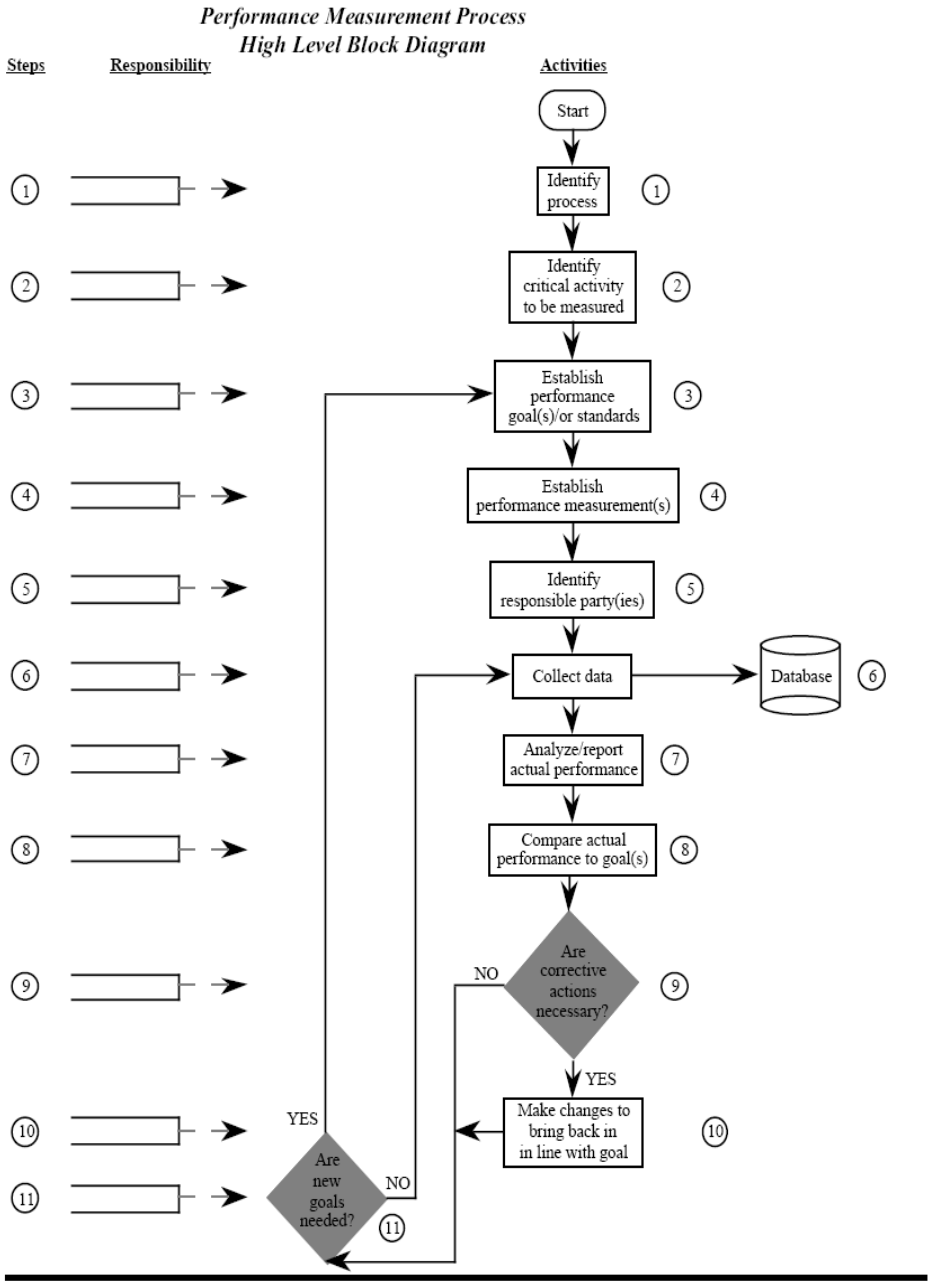

Figure 16. Performance Measurement Process Diagram
(from Dept of Energy handbook)

Note that the data collected during this process is maintained in a generic database. This process does not necessarily indicate that data is captured through all phases, although one can infer that as a possibility. We can use this model as a generic

template for measuring a performance and assume that an organization captures, formats, and stores the data in a database or data warehouse for future analysis.

1. Maturity Model

Another tool that aids in analyzing a process and the data output of that process comes form the world of software development. The Software Engineering Institute (SEI) developed a methodology called the Capability Maturity Model (CMM), now known as the Capability Maturity Model Integration (CMMI), to assess a contractors' process for software development. In addition to software, the Capability Maturity Model has also been used to understand the process maturity of organizations in many other diverse areas as well. The model assigns a five level framework to describe the process of a given organization. For instance, a Level 1 organization has no repeatable processes in place and the output is based on the competencies of an assigned team or individuals. A Level 2 organization has some repeatable processes in place to track issues such as cost, schedules and functionality. The model peaks with a Level 5 organization that is improving their processes on a continuous basis. An overview of the Capability Maturity Model is illustrated in Figure (17).

Level	Focus	Key Process Areas
5 Optimizing	*Continual process improvement*	Defect Prevention Technology Change Management Process Change Management
4 Managed	*Product and process quality*	Quantitative Process Management Software Quality Management
3 Defined	*Engineering processes and organizational support*	Organization Process Focus Organization Process Definition Training Program Integrated Software Management Software Product Engineering Intergroup Coordination Peer Reviews
2 Repeatable	*Project management processes*	Requirements Management Software Project Planning Software Project Tracking & Oversight Software Subcontract Management Software Quality Assurance Software Configuration Management
1 Initial	*Competent people and heroics*	

Figure 17. Capability Maturity Model Overview
(Software Process Improvement: Concepts and Practices. E. McGuire, Idea Group Publishing)

This model provides decision makers a methodology for reviewing the business processes of their organization in an unbiased manner. Many organizations claim to strive for continual process improvement but the reality may suggest otherwise upon analysis. One can also use this model as a means for reviewing output consistency from the process. While not explicitly stated in the CMM it is implied that the organization retains their various business processes and outputs in a construct of some sort. The larger point for discussion can be made in that we can examine any business process using the Department of Energy example and classify it using the Capability Maturity Model but in any event it is universally understood that for an organization to remain competitive it

must adhere to the ancient guidance of the Oracle of Delphi: Know Thyself. [39]Stated in modern terms, an organization must understand its own processes and outputs. In order to accomplish that this organization must be able to re-constitute records(data) of the actions taken during these processes.

The Maturity Model obviously has more utility than just a software development rating. It can be used as a means to examine any business process within an organization. This is particularly valuable for military training commands in that their processes are very repeatable and measurements can be taken at various intervals. The following will describe the overall system used by the two military communities in question.

C. SURFACE FLEET APPROACH

The Navy's surface forces adopted a system, the Training and Operational Readiness Information Services (TORIS), which contained all of the requirements a given ship would need to fulfill to certify in specific mission areas. This feeds another system, Training Figure of Merit (TFOM), so that managers at a macro level can monitor the progress and readiness level of that ship. The ship and her training partners, i.e. the certifying agency, input the information near real time so that the status is as up to date as possible.

1. TORIS

The implementation of TORIS served to remedy two compelling problems[40]:

- The amount of manpower required to capture and manipulate assessment data.
- The need to transform operational observations in to usable, digitized forms.

This program started as a pilot project to as a proof of concept for an essential set of tools needed by 'readiness managers' in the Navy. The Naval Surface Forces currently utilize TORIS and TFOM as a means to assist and document certification in multiple warfare areas. TORIS is"a database in which training requirements are kept, ship training

[39] "Know Thyself."http://www.philipcoppens.com/delphi.html.

[40] Opportunity Analysis for TORIS: ATGPAC.

events results are kept, and a source for standard, tailorable drill cards."[41] The intent is that TORIS will house all training tasks, whether certification-related or not. Figure (18) illustrates the TORIS enterprise system.

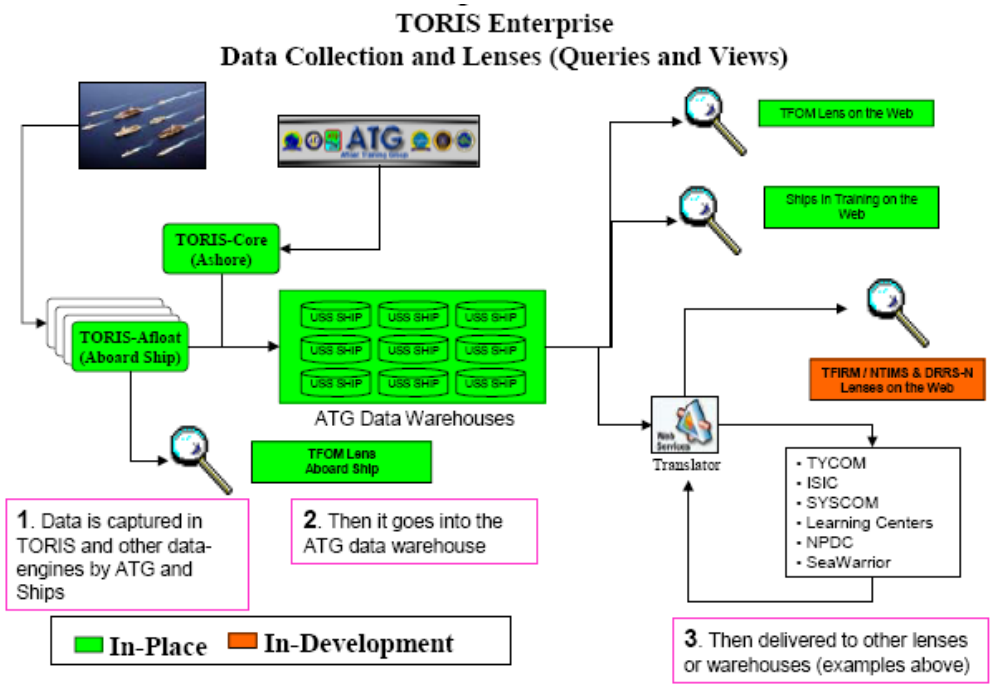

Figure 18. TORIS Enterprise View (From SFTM)

TFOM is "a readiness indicator…used by the ship to determine where to focus training efforts to maintain continuous readiness."[42] It is based on four 'pillars', or specified areas of organization, with each pillar having data points associated with it. These pillars are: Proficiency, Personnel, Management, and Material. The data points are weighed and fed into the figure of merit associated with that pillar. The pillar feeds in to the overall TFOM equation that translates in to a stoplight-based rating of green through red. Many of the data points that feed the TFOM equation(s) are 'rolled up' from TORIS, particularly in the Proficiency pillar. There is a Surface Warfare Development Group (SWDG) effort to expand the boundaries of TFOM outside the' unit level' in to the larger

[41] Commander, Naval Surface Forces Instruction 3502 Rev. C; Surface Force Training Manual (SFTM).

[42] Commander, Naval Surface Forces Instruction 3502 Rev. C; Surface Force Training Manual (SFTM).

context of strike group and fleet operations via ‘Tactical TFOM’. Information regarding Tactical TFOM is only available at present on classified networks and thus is outside the scope of this project. Figure (19) illustrates the TFOM Hierarchy.

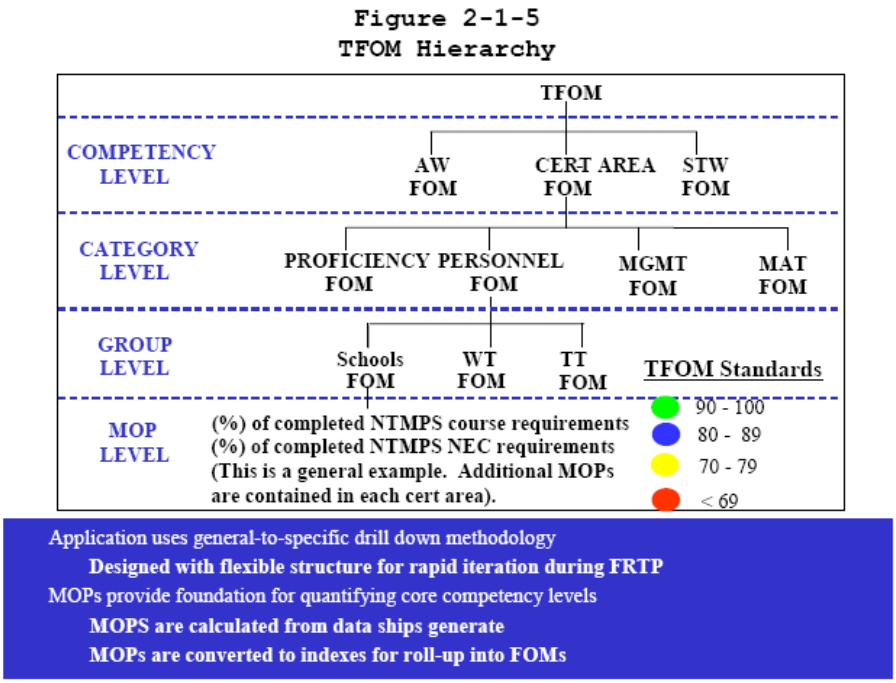

Figure 19. TFOM Hierarchy (From SFTM)

An analysis conducted prior to TORIS development identified existing issues with the former Surface Navy approach as it existed at that time. Notable issues that may pertain to the Patriot community include:

- The process for documenting/reporting/warehousing (assessment) data is manual and labor intensive
- Manual data entry not supportive of higher degrees of data analysis
- Difficulty in maintaining standardization across the various assessment locations and commands
- No mechanism available for data sharing between authoritative sources

The TORIS project instituted three tools that facilitated the management of readiness information: a portable system for data capture, a central web system, and a data sharing mechanism. The portable data system enabled efficient capture and transfer of data points observed during assessments to the central system. The central system

included web-centric applications to receive, store, manipulate and display data and readiness information. Data sharing was achieved with server software that responded to queries from external(to the assessing agency) data consumers in a machine-to-machine format. All of this by necessity was compliant with Navy Information Technology directives.

The data points captured in TORIS and TFOM are directly related to certification requirements from the Surface Force Training Manual. Most of the events conducted by a ship during a Ballistic Missile Defense training event or assessment fall under the Proficiency pillar. The resulting data is used by the readiness managers in the fleet hierarchy to determine performance and training trends among other issues. Unlike the Status of Readiness and Training System (SORTS), the data within TORIS and TFOM is unclassified. The SORTS database provides the fleet decision-makers a more holistic view of a given ship but also a more generic view as well. It may indicate that a ship is degraded in a mission area due to non-completion of an exercise but it does not indicate how well the ship has done in past exercises and to what degree.

Clearly, the Naval Surface Forces approach to certification is compatible with the Strategic Command Directive for missile defense participants. Additionally, this certification process and data collection methodology facilitates process improvement in that the data is collected and maintained in a format that is usable.

D. AIR DEFENSE ARTILLERY APPROACH

The Army's process is governed by Field Manual 3-01.86 and all of the requirements are followed via check sheets from that publication. The assessors of a Patriot Battery are personnel from the next echelon up within that Battery's chain of command and occasionally augmented by personnel from another Battery. There is no community-wide database that retains the training data. It can be assumed that the various chains of command keep a local database or spreadsheet of some sort for localized tracking.

1. FM 3-01.86

The publication defines the criteria for positive assessment within the various tables. These events are conducted and scored per the drill guidelines. An example drill guide is provided in Appendix B. The information to take away from reviewing the drill guide is that a sizable amount of data is manually recorded for each event. That information is not retained for common access by Army readiness managers.

2. Unit Status Reporting

The Unit Status Reporting system is equivalent to the SORTS tracking system. The Army uses a version of the SORTS software to prepare their Unit Status Reports (USRs). The information and data contained in USRs are entered into and maintained in the Army Status of Resources and Training System (ASORTS) database, which serves as the central registry and authorized database of record for all operational Army organizations and units.[43] This information updates the Global SORTS system (GSORTS) which is that central data system used by the Chairman, Joint Chiefs of Staff. The above systems are scheduled to be replaced by the Defense Readiness Reporting System (DRRS).

Units submit a USR on a regular basis and as needed when there is a significant change in status. The rating used within the system is determined by comparing the personnel, equipment and training status of unit with wartime requirements. It is the measure of a unit at a given point in time. The readiness ratings are described below:

- C1: combat ready, no deficiencies
- C2: combat ready, minor deficiencies
- C3: combat ready, major deficiencies
- C4: not combat ready
- C5: not combat ready, programmed

[43] Unit Status Reporting, Army Regulation 220-1.

In general, a Unit Status Report from a Patriot Battalion is very much akin to a SORTS message released by a Navy Cruiser. These reports provide operational-level and above planners the means to determine readiness and availability of units to respond to an operational requirement.

The Patriot community process of certification is compatible with the Strategic Command directive. It is not apparent that the process is necessarily conducive to a 'process improvement through data collection and analysis' approach. There does not appear to be a system in place that facilitates this organizational methodology.

E. SUMMARY

The Surface Navy system provides the user a means and a vehicle to track various data points, store that data in a usable format and display the data in meaningful ways to readiness managers and decision makers. It can loosely be aligned to the Capability Maturity Model Level Four in that the process is managed and driven by quantitative information that these systems provide. The Patriot process is possible the equivalent of a Level Two or Three system. Absent data collection at the unit level it is completely a subjective assignment. Clearly the system is repeatable by design but needs a much deeper level of data collection and data storage so that readiness managers can make decisions based on quantitative information.

V. CONCLUSION

The process used by the U.S. Army to certify Patriot crews in missile defense bears a generic resemblance to the process utilized by the U.S. Navy for the certification of ships in various warfare areas. In general both services combine successful completion of training scenarios with the validation of specific administrative requirements in a repetitive cycle that produces 'trained and ready' crews. The above-mentioned process is monitored, and to a certain extent validated, by the reporting senior officer (or proxy). Units that are part of the Ballistic Missile Defense System are required by Strategic Command to adhere to that organization's certification requirements as well. Generally, the parent service program is accepted by Strategic Command as meeting their requirements. As these programs are directed by official instruction, they are periodically reviewed. A typical review occurs every two years.

A. REVIEW

The Navy directive concerning Ballistic Missile Defense uses the same structure that the Navy uses for other warfare areas. In general, the warfare area is assessed under four readiness pillars. There is a concerted effort to quantify the areas of assessment which facilitates capturing detailed information in a number of areas. The Army Field Manual 3-01.86 provides very specific guidance for operators and maintainers on what actions need to be taken. This type of direction lends itself to relatively easy quantification. However, this information is not categorized using the pillar concept (material, management, etc.) but by the functional components of a Patriot battery.

An inventory of a typical Navy certification data sheet reveals 17 quantitative items measured and 222 qualitative items measured. The various Patriot check sheets account for over 300 items evaluated during certification. At present they are all in a qualitative form. It is technically possible to develop an information system in which the certifier or assessor can enter certification data in digital form. It is also possible to transform some of the qualitative items into a quantitative form. For example, a typical event includes an item in the form of "Assign target to Firing Unit" or "Resolve

equipment casualty;" these could easily be modified to "Assign target to Firing Unit within x timeframe" or "Resolve equipment casualty within x timeframe." In most cases, these are already part of the drill anyway. The guidance and methodology are similar enough so that one can easily envision how the TORIS model could be adopted by another community or service branch.

Assuming that there is agreement on the value of capturing corporate memory about the certification process the next step will include what product or solution would best fit the enterprise. The adoption of an enterprise-level solution for process management and data capture is a significant undertaking. It is also necessary to ensure that a project of this magnitude is initiated in a well-defined manner from the outset. According to Plato, "The beginning is the most important part of the work." Options include co-opting the Navy model of TORIS, creating a solution internally or soliciting other solutions from external sources. It is recommended that, at a minimum, the Air Defense Artillery community examine the concept of an organizational memory construct for their own use.

B. CHANGE MANAGEMENT

Beyond the technical aspect of finding and instituting an enterprise-level, digital solution to the problem of retaining corporate memory, readiness managers at the executive level should be aware of resistance to change at the personnel level. For instance, the operational Army Patriot community is just one segment that would need to adapt to this new way of conducting, and more significantly, recording, business. The Army Training and Doctrine Command (TRADOC) can be considered the owning interest among the stakeholders. They publish the overall certification standard and any modification to the certification procedure must be vetted and approved by TRADOC. A possible response (in some circles) would be to challenge the need to modify an already-in-place-and-working-system. Why fix something if it is not broken? It is unclear whether decision-makers in the Patriot community, TRADOC included, consider the lack of enterprise-wide information availability regarding certification progress or the lack of a feedback loop to the schoolhouse organizations as a problem. This issue makes

implementing, or at least recommending, a change more complicated. Additionally, this change is not 'adding IT' to the back-end data collection part of the certification process; it is intended to accomplish what Markus describes as 'technochange'[44]: a "significant improvement…in organizational outcome measures." In this case, an example of improvement is expected to be in the quality of feedback data from operational Patriot units back to the parent training community.

In change management a commonly accepted change equation is awareness of present state inadequacy (that leads to dissatisfaction) plus the revealing of an ideal or better future must be less than or equal to the cost of the change. Decision-makers must be aware of this equation prior to instituting any significant process change. We can review the factors of that equation by community to find potential points of contention.

The possibility of resistance to a technochange was mentioned earlier as it relates to the adoption of a computer-aided, data-driven system to replace the publication-based check sheets used by the Army during Patriot training and certification. This approach is common within the Army and is deeply embedded as a norm. The first factor in the equation is the creation of awareness that will lead to dissatisfaction with the checksheet approach. The point needs to be made that there is untold loss of data points in every Patriot graded (or un-graded) training evolution as long as the data is recorded on paper and filed away. Even if filed somewhere that data is not likely to be accessible to readiness managers or personnel within the larger training community. This information could potentially be warehoused in an electronic fashion and used by both operating and training agencies. At the Brigade level, the organization that assesses and certifies operating units, there is a tremendous opportunity to address common shortcomings during exercises.

Turning to the idea of presenting the target audience with an 'ideal' future, we can use the current Navy system as an example of a system that stores all of the certification requirements, monitors and updates unit progress or status, and provides that information not only to units and their commanders but also the training communities within the

[44] M. Lynne Markus. "Technochange management: using IT to drive organizational change." *Journal of Information Technology* (2004) 19.

various warfare areas. These 'Centers of Excellence' may not act upon that information but they have the option to do so. This is not a capability that currently resides within the TRADOC organization but the possibility for it to do so is realistic, viable and could provide a competitive advantage.

There are at least two types of costs to assess in the change equation. The obvious one, financial, is outside the scope of this paper but can be estimated as relatively low for future use. For example, the Navy system was initially developed at a local command level, not at SPAWAR, at little direct economic expense. The less obvious cost is in terms of social capital. This can also be thought of as organizational culture capital. As described previously, this cost will likely be high. The cost is perhaps in the turmoil created by the "dialectic between old memory and new knowledge"[45] where personnel invested in the old system, the checksheet approach, are moved to utilize an electronic aid. Assuming the TRADOC decision makers adopt a TORIS/TFOM-like system we can anticiapte that there will be buy-in from upper management. In the military there is an assumption that once 'top brass' institutes a policy there is immediate and unquestioned acceptance. Human nature indicates otherwise. There will be a social cost to pay and how the Patriot community, particularly at the Brigade level, approaches this cost will determine the ease or difficulty of implementation.

The goals, as mentioned in the Surface Force Training Manual, are based on time reduction rather than stakeholder value. The change, and current transition, was directed from the top; the Surface Force Type Commander has immense authority as a force provider to the various operating fleets. The focus on 'structure and systems' seems evident. This may be a by-product of military culture in general but it serves as a reminder that the Navy implementation is more system-focused and less socio-cognitive based.

The analysis above is not necessarily as comprehensive as it could be. The stakeholders within the missile defense community, at a minimum, would be well-served

[45] Daniel Robey, Jeanne Ross, Marie-Claude Boudreau. "Learning to implement enterprise systems: An exploratory study of the dialectics of change." *Journal of Management Information Systems*; Summer 2002 Vol.19.

to conduct a thorough study on the benefits of a system to determine feasibility. Nor is the analysis meant to be critical; we are not likely to find a strategy that everyone will like and then implement it in a popular manner as well. If one ventures to the Surface Warfare Officer community of practice site called SWONET[46] you are likely to find as much negative commentary on TORIS or TFOM as you will find positive. Therefore, we can conclude that although the systems themselves are operational and likely effective, the effort made to implement them was imperfect.

A cautionary note: this is not a suggestion that the Patriot community blindly follow the direct path taken by the Navy, nor is it meant to imply that they obtain TORIS from the Navy, change the names/labels of the data points and throw away the value of the pre-existing system. In other words, "don't try to impose a canned solution developed somewhere else."[47]To do so ignores organizational culture and will generate more 'cost' in units of resistance than is necessary. The change to a TORIS and TFOM-like model must be carefully thought out with as much detail as is available. The consequence for actual Patriot Battalions and Batteries remains significant. Not only is the certification of the units critical in deploying as an Air Defense capability, any stoppage or slowing of the ability to deploy could have potentially harmful results on the battlefield. Thus,

> it must be integrated in a way that addresses its impact throughout…it cannot deliver sustainable performance improvements unless it is part of a program that acknowledges and addresses the changes reengineering requires of corporate culture, configuration and coordination, and in…(the deployment) of its human, technological and information resources…..changes in any one dimension must be balanced with changes in every other dimension.[48]

Using the technochange idea from before, Markus recommends prototyping as characteristic of a good process. To take that one step further, it is possible to create a "virtual" Patriot Battery to examine what a Patriot-based TORIS system would look like

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[46] SWONET https://www.swonet.com.

[47] Richard Luecke. "Managing Change and Transition." Harvard Business Essentials, 2003.

[48] Donald Marchand, M.J. Stanford. "Business process Re-Design: A Framework for Harmonizing People, Information and Technology." Business Process Change; Reengineering Concepts, Methods and Technologies. p. 37.

and, more importantly, what that Battery would experience as it uses the new system. This could theoretically eliminate unnecessary obstacles and provide the decision makers with an estimate of what this system would mean to a Battalion or Battery.

It not much of a technological challenge to implement a database that contains all of the certification requirements, down to a granular level, that could be used by Patriot units. The Navy has a pre-existing product in the form of TORIS and TFOM that meets the needs of Naval surface forces and could be adopted to meet the needs of Army Patriot assets as well. The challenge is in (a) achieving Army buy-in at the appropriate level of command, (b) creating an environment in which a new certification process is willingly accepted, (c) recognizing the second and third order effects of the process change as it relates to the rest of the Army, specifically outside the Air Defense community, and (d) the same recognition of effects within the Air Defense community. The change equation reminds us to not ignore the 'cost' of this change. Whether the strategy taken is swift and hierarchical, or deliberate and flattened, there will be resistance.

C. RECOMMENDATIONS

Based on the work done on this thesis, the following recommendations are offered:

The certification processes in general follow a pattern of increasingly challenging milestones to be met prior to a culminating event. Every effort should be made to capture data associated with these milestone actions. It is recommended that the Missile Defense Agency and/or Strategic Command introduce an initiative to record and retain data associated with these events down to a granular (unit) level. In some cases, this data is already available to the parent service. It is further recommended that the Patriot community in particular consider an information technology solution for the issue of unit-level readiness management. Quite possibly this solution may be applicable to more than just the Air Defense Artillery community within the Army. The Navy should consider converting the TORIS product into a more automated format, requiring less user involvement. This would eliminate any bias from the individual doing data entry and also minimize the perception of TORIS as an inconvenience to shipboard crews.

D. FUTURE WORK

This thesis was limited in scope to only two elements within the Ballistic Missile Defense System. It is recommended that future research include other elements to include Air Force units, paying particular attention to the certification criteria used by the parent service. It also recommended that this research include the process that captures the discreet certification data. If this process is already automated in some capacity then an additional research area would be to investigate the linkage of that data to other readiness management systems.

A research area that appears to have the most immediate need concerns the lack of an automated readiness management system within the Patriot Air Defense Artillery community. A model of a system (or systems) could be constructed for the community for and/or approval. This could be loosely based on the Navy's TORIS system but could also be developed using other enterprise-level solutions from the commercial sector. A future project should include a detailed cost-benefit analysis of enterprise solutions available.

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APPENDIX A: EXAMPLE BMD TORIS DATA CARD

The spreadsheet below details the information assessed and captured during a unit level Ballistic Missile Defense training event on a given Aegis warship.

WBS	Narrative								
BMD-MATL01	Combat Systems Suite Operability	0		Rollup					720
BMD-MATL01.01.01	PERCENT of newly installed equipment/software that has been installed since last ULTRA and has been SOVT'D.	1	LAST	70	100-90%	89-80%	80-70%	69-0%	720
BMD-MATL01.01.02	PERCENT of all required equipment and hardware necessary to support execution of a complex scenario.	1	LAST	70	100-90%	89-80%	80-70%	69-0%	90
BMD-MATL01.01.03	Did embedded training device material discrepancies not impact accomplishment of training objective?	1	LAST	Y	YES			NO	90
BMD-MATL01.01.04	Was an ATG/ISIC observed OCSOT successfully completed?	1	LAST	Y	YES			NO	720
BMD-MATL01.01.05	Was an ATG/ISIC observed BMDSOT successfully completed?	1	LAST	Y	YES			NO	720
BMD-MATL01.01.06	Was an ATG/ISIC observed TSOT successfully completed?	1	LAST	Y	YES			NO	720
BMD-MATL01.01.07	Was an ATG/ISIC observed DSOT successfully completed?	1	LAST	Y	YES			NO	720
BMD-MATL02	Successfully receive LRS&T/BMDD Engagement mission tasking and warnings via portable training system.	0		Rollup					90
BMD-MATL02.01	Was Embedded/Portable training device operational?	1	LAST	Y	YES			NO	90
BMD-MGMT01	Completion of ASA Check sheets	0		Rollup					720
BMD-MGMT01.01	What is the percent of ASA Checklist items in full compliance?	1	LAST	70	100-90%	89-80%	80-70%	69-0%	720
BMD-MGMT01.02	Is there a plan to correct all deficiencies? (If 100% of items are in full compliance, enter Yes)	1	LAST	Y	YES			NO	720
BMD-MGMT02	Battle Orders signed by current Commanding Officer	1	LAST	Y	YES			NO	720
BMD-MGMT03	Watch Team Replacement Plan (WTRP)	0		Rollup					90
BMD-MGMT03.01	Does the WTRP include required watch teams?	1	LAST	Y	YES			NO	90
BMD-MGMT03.02	Does the WTRP include	1	LAST	Y	YES			NO	90

	the training team?								
BMD-MGMT03.03	Does the WTRP extend one year into the future, quarter by quarter, to preclude unnecessary watch team changes that adversely affect training progress for the team as a whole?	1	LAST	Y	YES			NO	90
BMD-PERS01	Meet 80% Required Schools	0		Rollup					90
BMD-PERS01.01	What is the PERCENT of all NTMPS required courses? (Use the SOP on ATG's web site to determine this PERCENT.)	1	LAST	70	100-90%	89-80%	80-70%	69-0%	90
BMD-PERS01.02	How many unfulfilled course requirements are NOT matched with confirmed quotas?	1	LAST	1	0			=>1	90
BMD-PERS01.03	Is there a long range school/course management plan projecting four quarters?	1	LAST	Y	YES			NO	90
BMD-PERS02	PQS Qualified Training Team capable of training all watch teams	0		Rollup					90
BMD-PERS02.01	What is the number of training team members NOT qualified for the positions they're observing.	1	LAST	1	0			=>1	90
BMD-PERS02.02	What is the number of training team members NOT designated in writing by the Commanding Officer.	1	LAST	1	0			=>1	90
BMD-PERS03	PQS Qualified Watch Teams (Determined from RADMIN printout)	0		Rollup					90
BMD-PERS03.01	What is the number of watchstanders for BMD, watchsection 1 NOT PQS qualified.	1	LAST	1	0			=>1	90
BMD-PERS03.02	What is the number of watchstanders for BMD, watchsection 2 NOT PQS qualified.	1	LAST	1	0			=>1	90
BMD-PERS03.03	What is the number of watchstanders for BMD watchsection 3 (CSTT), NOT PQS qualified.	1	LAST	1	0			=>1	90
BMD-PROF01	Training Team proficiency	0		Rollup					210
BMD-PROF01.01	Establish Training Teams and Training Program	0		Rollup					210
BMD-PROF01.01.01	Train and Qualify Training Teams	1	LAST	Y	YES			NO	210
BMD-PROF01.01.01.01	Were all TT members designated in writing by commanding officer?	0							210
BMD-PROF01.01.01.02	Were all TT members PQS/JQR qualified, including interim qual, to observe the watch	0							210

	stations being evaluated?								
BMD-PROF01.02	Plan and Prepare for Training Event(s)	0		Rollup					210
BMD-PROF01.02.01	Initial Planning	1	LAST	Y	YES			NO	210
BMD-PROF01.02.01.01	Were watch teams and watchstanders per approved watch bill?	0							210
BMD-PROF01.02.01.02	Was feedback and lessons learned from the last occurrence of this exercise reviewed in the planning process?	0							210
BMD-PROF01.02.01.03	Were new drill guides hot checked prior to inclusion in the package?	0							210
BMD-PROF01.02.02	Conduct Operational Risk Management (ORM)	1	LAST	Y	YES			NO	210
BMD-PROF01.02.02.01	Was an assessment of hazards conducted?	0							210
BMD-PROF01.02.02.02	Were risk decisions and controls identified?	0							210
BMD-PROF01.02.02.03	Were controls implemented and communicated to lowest level?	0							210
BMD-PROF01.02.02.04	Was proper supervision of the evolution carried out?	0							210
BMD-PROF01.02.02.05	Were safety procedures and operational risk management considered?	0							210
BMD-PROF01.02.02.06	Was a response plan established in the event of an actual casualty?	0							210
BMD-PROF01.02.03	Scenario Package	1	LAST	Y	YES			NO	210
BMD-PROF01.02.03.01	Did drill guides/plans provided stimulate systems and use applicable embedded training systems to provide maximum realism?	0							210
BMD-PROF01.02.03.02	Were applicable embedded training systems used?	0							210
BMD-PROF01.02.03.03	Were training team communications identified?	0							210
BMD-PROF01.02.03.04	Were watch team communications identified?	0							210
BMD-PROF01.02.03.05	Were procedures for maintaining real world navigation and tactical picture included in the package?	0							210
BMD-PROF01.02.03.06	Was the exercise scheduled through the chain of command to ensure required resources were available (e.g. equipment, personnel) to support	0							210

	exercise?								
BMD-PROF01.02.03.07	Did the ITT and TT identify coordination required between departments to achieve integrated training and casualty control objectives?	0							210
BMD-PROF01.02.03.08	Was the exercise package approved in writing by the commanding officer?	0							210
BMD-PROF01.03	Brief Training Event(s)	0		Rollup					210
BMD-PROF01.03.01	TT Coordination with ITT	1	LAST	Y	YES			NO	210
BMD-PROF01.03.01.01	Were individual TT coordination requirements briefed?	0							210
BMD-PROF01.03.02	Brief Individual TT	1	LAST	Y	YES			NO	210
BMD-PROF01.03.02.01	Were evaluation sheets reviewed and distributed?	0							210
BMD-PROF01.03.02.02	Were coordination requirements briefed?	0							210
BMD-PROF01.03.02.03	Were exercise initiators, safety observers, and evaluators assigned and briefed?	0							210
BMD-PROF01.03.02.04	Was the level of training team involvement briefed?	0							210
BMD-PROF01.03.02.05	Were embedded trainers to be used briefed?	0							210
BMD-PROF01.03.02.06	Were any actual or simulated changes to the plant or equipment status briefed to the TT?	0							210
BMD-PROF01.03.02.07	Was coordination for use of embedded trainers discussed?	0							210
BMD-PROF01.03.02.08	Were exercise simulations and deviations discussed?	0							210
BMD-PROF01.03.02.09	Were exercise disclosure procedures and timing discussed?	0							210
BMD-PROF01.03.02.10	Were casualty insertion procedures and timing discussed?	0							210
BMD-PROF01.03.02.11	Were all integration points identified?	0							210
BMD-PROF01.03.02.12	Were primary and alternate communications for training team members identified?	0							210
BMD-PROF01.03.03	Brief Safety and Training Time Out Procedures	1	LAST	Y	YES			NO	210
BMD-PROF01.03.03.01	Were training time out procedures briefed?	0							210
BMD-PROF01.03.03.02	Were safety procedures and operational risk management briefed?	0							210
BMD-PROF01.03.03.03	Was control of cascading casualty control events discussed?	0							210

BMD-PROF01.03.03.04	Was a response plan established in the event of an actual casualty?	0							210
BMD-PROF01.03.03.05	Was real world tactical situation/considerations briefed to all team members?	0							210
BMD-PROF01.03.03.06	Was feedback from the last time this exercise was conducted briefed?	0							210
BMD-PROF01.03.04	Brief Watch Teams	1	LAST	Y	YES			NO	210
BMD-PROF01.03.04.01	Was an exercise brief conducted within 24 hours of the event?	0							210
BMD-PROF01.03.04.02	Did watch team attended the brief?	0							210
BMD-PROF01.03.04.03	Was an exercise time or schedule of events published?	0							210
BMD-PROF01.03.04.04	Were major events discussed, particularly for at-sea exercises?	0							210
BMD-PROF01.03.04.05	Was real world tactical situation/considerations briefed to all team members?	0							210
BMD-PROF01.03.04.06	Were any actual or simulated changes to the plant or equipment changes briefed to watchstanders and watch teams?	0							210
BMD-PROF01.04	Execute Training Event(s)	0		Rollup					210
BMD-PROF01.04.01	Were preparations properly executed?	1	LAST	Y	YES			NO	210
BMD-PROF01.04.01.01	Did evaluators arrive on station before exercise COMEX and conduct required safety walk-through?	0							210
BMD-PROF01.04.01.02	Were special safety considerations identified during risk assessment reviewed?	0							210
BMD-PROF01.04.01.03	Did training team members safely rig simulations or alter equipment/system configurations to achieve exercise objectives?	0							210
BMD-PROF01.04.01.04	Was a sight inventory and/or op-test of all equipment completed prior to drill?	0							210
BMD-PROF01.04.01.05	Were props/publications prestaged as required?	0							210
BMD-PROF01.04.01.06	Was a time check conducted prior to COMEX?	0							210
BMD-PROF01.04.01.07	Were coordination and internal communications sufficient to support exercise objectives?	0							210
BMD-PROF01.04.02	Was event properly executed?	1	LAST	Y	YES			NO	210
BMD-PROF01.04.02.01	Were casualties imposed	0							210

	as briefed?								
BMD-PROF01.04.02.02	Were scenario messages delivered as briefed?	0							210
BMD-PROF01.04.02.03	Was time line maintained?	0							210
BMD-PROF01.04.02.04	Were disclosures per approved ship's disclosure list	0							210
BMD-PROF01.04.02.05	Did evaluators provide only minimum prompting to prevent disruption of the exercise?	0							210
BMD-PROF01.04.02.06	Were safety observers on station?	0							210
BMD-PROF01.04.02.07	Did the team internally update and pass key information?	0							210
BMD-PROF01.04.02.08	Did casualties have appropriate cause and effect?	0							210
BMD-PROF01.04.02.09	Were training time-outs called when required?	0							210
BMD-PROF01.04.02.10	Were safety procedures used and enforced?	0							210
BMD-PROF01.04.02.11	Were all unsafe conditions recognized and/or corrected before occurrence of casualty?	0							210
BMD-PROF01.04.02.12	Was the training team supervision and control of the exercise effective?	0							210
BMD-PROF01.04.03	Assess Team and Individual Performances	1	LAST	Y	YES			NO	210
BMD-PROF01.04.03.01	Did evaluators observe and evaluate all factors in drill guides and on evaluation sheets?	0							210
BMD-PROF01.04.03.02	Did evaluators verbally question watch standers?	0							210
BMD-PROF01.04.03.03	Did imposed casualties tactically impact performance?	0							210
BMD-PROF01.04.04	What PERCENT of planned integration points were successfully executed? Integration is defined in SFTM para 3106.	1	LAST	60	100-86%	85-71%	70-60%	59-0%	210
BMD-PROF01.05	Debrief Training Event(s)	0		Rollup					210
BMD-PROF01.05.01	Conduct Post-Event Watchstander / Watch Team Debrief	1	LAST	Y	YES			NO	210
BMD-PROF01.05.01.01	Was a watchstander / watch team debrief conducted by the TT within 2 hours of exercise completion?	0							210
BMD-PROF01.05.01.02	Did the watch team debrief provide descriptive (what happened), evaluative (how well) and diagnostic (why success or failure) feedback of the training event?	0							210

BMD-PROF01.05.01.03	Were safety violations and deviations from doctrine addressed?	0							210
BMD-PROF01.05.01.04	Did training teams identify enabling objectives met/not met?	0							210
BMD-PROF01.05.02	Conduct Post-Event Training Team Debrief	1	LAST	Y	YES			NO	210
BMD-PROF01.05.02.01	Were individual TT debriefs conducted by the integrated TT?	0							210
BMD-PROF01.05.02.02	Did training teams identify enabling objectives met/not met?	0							210
BMD-PROF01.05.02.03	Did the training team self-correct mistakes?	0							210
BMD-PROF01.05.02.04	Were completed evaluation sheets and exercise comments forwarded to the commanding officer?	0							210
BMD-PROF01.05.02.05	Were lessons learned documented in writing?	0							210
BMD-PROF01.06	What is the difference in TFOM score of the Mission Area between ATG at last ULTRA and the ship at last ULTRA?	1	LAST	10	0-4%	5-8%	9-10%	>10%	210
BMD-PROF02	Demonstrate proficiency in a complex level BMD LRS&T and Engagement Scenario	0		Rollup					90
BMD-PROF02.01	Analyze and plan for an LRS&T/engagement mission	0		Rollup					90
BMD-PROF02.01.01	Was Watchteam INTEL brief conducted?	1	AVG	Y	YES			NO	90
BMD-PROF02.01.01.01	Did brief review applicable items of the CSTP and CTM?	0							90
BMD-PROF02.01.01.02	Did the brief review applicable readiness condition (REDCON)	0							90
BMD-PROF02.01.01.03	Did the brief review Navy Wide OPTASK?	0							90
BMD-PROF02.01.01.04	Did the brief review applicable TACMEMOS?	0							90
BMD-PROF02.01.01.05	Did the brief review applicable items of the CO's Battle Orders?	0							90
BMD-PROF02.01.01.06	Did the brief review the communications plan?	0							90
BMD-PROF02.01.01.07	Did the brief review which watchstation will make the call to role back to self defense?	0							90
BMD-PROF02.01.01.08	Did the brief review Enemy Order of Battle (EOB)/ Enemy Electronic Order of Battle (EEOB)/ Enemy Missile Order of Battle(EOB)?	0							90
BMD-PROF02.01.01.09	Did the brief review threat capabilities, limitations and counter detection ranges?	0							90
BMD-PROF02.01.01.10	Did the brief include an	0							90

	intelligence summary of the AOR?								
BMD-PROF02.01.01.11	Did the brief review environmental information?	0							90
BMD-PROF02.01.01.12	Did the brief review current equipment operational status?	0							90
BMD-PROF02.01.01.13	Did the brief cover non-organic assets available?	0							90
BMD-PROF02.01.01.14	Did the brief cover assigned defended areas?	0							90
BMD-PROF02.02	Initialize and Configure/Reconfigure systems to include transition from BMD to baseline tactical.	0		Rollup					90
BMD-PROF02.02.01	Were sensors and associated systems configured to support Free Form/Predefined Radar Doctrine.	1	AVG	Y	YES			NO	90
BMD-PROF02.02.01.01	Did AAWC/CSC define launch area?	0							90
BMD-PROF02.02.01.02	Did CSC/AAWC define ship operating area?	0							90
BMD-PROF02.02.01.03	Did RSC select launch area defined by AAWC/CSC?	0							90
BMD-PROF02.02.01.04	Were SPY sectors developed to support tracking objective IAW mission planner and independently verified by designated watchstander?	0							90
BMD-PROF02.02.01.05	Were sectors manually initiated/associated IAW mission planner?	0							90
BMD-PROF02.02.01.06	Did CSC/AAWC enable ownship in BMD on station alert?	0							90
BMD-PROF02.02.01.07	Did CSC/AAWC enable remote engagement authorized?	0							90
BMD-PROF02.02.02	Configure sensors and associated systems to support SPY Cued Acquisition.	1	AVG	Y	YES			NO	90
BMD-PROF02.02.02.01	Was cued acquisition initiated via C&D doctrine or manual VAB action?	0							90
BMD-PROF02.02.02.02	Did CSC define a Point of Interest for cued acquisition doctrine?	0							90
BMD-PROF02.02.02.03	Was a re-attempt made if first attempt unsuccessful?	0							90
BMD-PROF02.03	Demonstrate successful surveillance and tracking against 3 long range, simulated ballistic missiles	0		Rollup					90

BMD-PROF02.03.01	Did BMD watchteam demonstrate successful surveillance and tracking in support of LRS&T mission.	1	AVG	Y	YES			NO	90
BMD-PROF02.03.02	Was track categorized as either Air or BM?	0							90
BMD-PROF02.03.03	Was primary object identified?	0							90
BMD-PROF02.03.04	Were new tracks(child tracks) detected?	0							90
BMD-PROF02.03.05	Were voice reports made IAW OPTASK COMMS?	0							90
BMD-PROF02.03.06	Were proper voice reports made if system is down w/in 5 minutes?	0							90
BMD-PROF02.04	Demonstrate the ability to send and receive cueing data via SAT Link 16.	1	AVG	Y					90
BMD-PROF02.05	Effectively operate all installed BMD information and reporting systems.	0		Rollup					90
BMD-PROF02.05.01	Was C&D Adjunct initialized IAW CSOSS?	1	AVG	Y	YES			NO	90
BMD-PROF02.05.01.01	Was C&D Adjunct data recording initialized?	0							90
BMD-PROF02.05.01.02	Was system reconfigured from tactical to BMD w/in 20 minutes?	0							90
BMD-PROF02.05.01.03	Were the applicable weapons systems placed in stand alone mode?	0							90
BMD-PROF02.05.01.04	Did the watchstanders demonstrate knowledge and procedures of firebreaks in applicable weapon systems?	0							90
BMD-PROF02.05.02	Was Mission Planner initialized IAW User Guide?	1	AVG	Y	YES			NO	90
BMD-PROF02.05.03	Was the data entered correctly into Mission Planner?	1	AVG	Y	YES			NO	90
BMD-PROF02.05.03.01	Was ships mission (surveillance or engagement) entered?	0							90
BMD-PROF02.05.03.02	Was task type (surveillance or engagement) entered?	0							90
BMD-PROF02.05.03.03	Was task priority (primary or secondary) entered?	0							90
BMD-PROF02.05.03.04	Was launch area(s) (location, size, orientation) entered?	0							90
BMD-PROF02.05.03.05	Was defended area(s)/asset(s) (location, size, orientation) entered?	0							90
BMD-PROF02.05.03.06	Were the threat types(for each associated launch area) entered?	0							90
BMD-PROF02.05.03.07	Was ship position (lat/long) entered?	0							90

BMD-PROF02.05.03.08	Was SPY search elevation entered?	0							90
BMD-PROF02.05.03.09	Was minimum water depth entered?	0							90
BMD-PROF02.05.03.10	Was Weapons Doctrine(s) entered?	0							90
BMD-PROF02.05.03.11	Was Defended Area Footprint calculated?	0							90
BMD-PROF02.05.03.12	Was Launch Area Denied calculated?	0							90
BMD-PROF02.05.03.13	Was SM-3 missile type entered?	0							90
BMD-PROF02.05.03.14	Was radar sensitivity accurately entered?	0							90
BMD-PROF02.05.03.15	Was Mission Planner data recording initialized at start-up?	0							90
BMD-PROF02.05.04	Was Vertical Launching System (MK 41) properly initialized?	1	AVG	Y	YES			NO	90
BMD-PROF02.05.04.01	Was LCU(s) initialized IAW CSOSS?	0							90
BMD-PROF02.05.04.02	Were CSES enabled for applicable cells by launcher crew?	0							90
BMD-PROF02.05.04.03	Was FIS/RLEP enabled?	0							90
BMD-PROF02.05.05	Did the operator initialize JTT-M IAW EE130-DU-OMI-010/USQ-151 Maintenance Turn-On and Operation procedures?	1	AVG	Y	YES			NO	90
BMD-PROF02.05.05.01	Did the operator load COMSEC IAW EE130-DU-OMI-010/USQ-151 Load Key Procedures procedures?	0							90
BMD-PROF02.05.06	Did CSC/ AWC receive IBS-S missile queuing alert from AN/USQ-151 (JTT-M)?	1	AVG	Y	YES			NO	90
BMD-PROF02.05.07	Was Missile Acquisition Data transmitted via AN/USQ-151 (JTT-M)?	1	AVG	Y	YES			NO	90
BMD-PROF02.05.07.01	Did RSC build a Dynamic Test Track (DTT) utilizing A-STATS/ ACTS	0							90
BMD-PROF02.05.07.02	Did unit transmit DTT over IBS-I network.	0							90
BMD-PROF02.06	Demonstrate the ability to conduct area-defense while configured for BMD mission	0		Rollup					90
BMD-PROF02.06.01	Were applicable systems available while configured for BMD mission?	1	AVG	Y	YES			NO	90
BMD-PROF02.06.01.01	Was CIWS available while configured for BMD mission?	0							90
BMD-PROF02.06.01.02	Was the 5” Gun available while configured for BMD mission?	0							90
BMD-PROF02.06.01.03	Was the AN/SPS-49	0							90

	available while configured for BMD mission?								
BMD-PROF02.06.01.04	Was SCUS available while configured for BMD mission?	0							90
BMD-PROF02.06.02	Engage threat(s) with ownships area-defense weapon(s) while configured for BMD mission.	0		Rollup					90
BMD-PROF02.06.02.01	Was the RSC able to maintain appropriate AAW Search Frame Times while configured for BMD?	1	AVG	Y	YES			NO	90
BMD-PROF02.06.02.02	What is the PERCENT of successful SM-2 engagements?	1	AVG	70	100-90%	89-80%	80-70%	69-0%	90
BMD-PROF02.06.02.03	Engage threat(s) with point defense system (CIWS).	1	AVG	Y	YES			NO	90
BMD-PROF02.06.02.04	Engage threat(s) with gun fire control system.	1	AVG	Y	YES			NO	90
BMD-PROF02.06.02.05	Engage threat(s) with ESSM.	1	AVG	Y	YES			NO	90
BMD-PROF02.07	Control Combat Systems Casualty Area Supervisor.	0		Rollup					90
BMD-PROF02.07.01	Was OPSCAP report made w/in 5 minutes?	1	AVG	Y	YES			NO	90
BMD-PROF02.07.02	Equipment casualty restoral in BMD spaces	1	AVG	Y	YES			NO	90
BMD-PROF02.07.02.01	Was the equipment casualty observed and reported to CSOOW/ECC?	0							90
BMD-PROF02.07.02.02	Was initial investigation of casualty conducted?	0							90
BMD-PROF02.07.02.03	Was alternate equipment configuration available and utilized?	0							90
BMD-PROF02.07.02.04	Was technical proficiency demonstrated?	0							90
BMD-PROF02.07.02.05	Was the casualty repaired?	0							90
BMD-PROF02.07.02.06	Were all reports made?	0							90
BMD-PROF02.07.03	Proper use of Electronic Casualty Control/CSOSS folder in BMD spaces	1	AVG	Y	YES			NO	90
BMD-PROF02.07.03.01	Was an Electronic Casualty Control folder/CSOSS manual available?	0							90
BMD-PROF02.07.03.02	Was the Electronic Casualty Control folder/CSOSS manual complete?	0							90
BMD-PROF02.07.03.03	Was the Casualty control folder/CSOSS manual used?	0							90
BMD-PROF02.07.03.04	Was the correct Electronic Casualty Control/CSOSS procedure used for each casualty?	0							90

BMD-PROF02.08	Engage BM Target	0		Rollup					90
BMD-PROF02.08.01	Was appropriate weapon doctrine statements activated?	1	AVG	Y	YES			NO	90
BMD-PROF02.08.01.01	Was Spy radar configured per CSTP/CO's battle orders?	0							90
BMD-PROF02.08.01.02	Was C&D configured per CSTP/CO's battle orders?	0							90
BMD-PROF02.08.01.03	Was WCS configured per CSTP/CO's battle orders?	0							90
BMD-PROF02.08.01.04	Was automatic/semi-automatic weapon doctrine selected IAW CO's Battle Orders?	0							90
BMD-PROF02.08.02	Was the target(s) engaged with SM-3 missile(s)?	1	AVG	Y	YES			NO	90
BMD-PROF02.08.02.01	Was equipment and associated systems configured per CO's battle orders/CSTP?	0							90
BMD-PROF02.08.02.02	Were pre-fire checks completed for applicable systems?	0							90
BMD-PROF02.08.02.03	Was Launcher manning per Combat System Doctrine?	0							90
BMD-PROF02.08.02.04	Were required keys on station per governing directives?	0							90
BMD-PROF02.08.02.05	Was the lethal object designated?	0							90
BMD-PROF02.08.02.06	Was target correctly identified as Group A/B?	0							90
BMD-PROF02.08.02.07	Was engagement order sent to C&D via CSC or AAWC?	0							90
BMD-PROF02.08.02.08	Was automatic/semi-automatic weapon selection doctrine activated?	0							90
BMD-PROF02.08.02.09	Was Fire Authorization Bypass enabled?	0							90
BMD-PROF02.08.02.10	Was proper report made by MSS?	0							90
BMD-PROF02.08.02.11	Were appropriate voice reports made IAW current OPTASK?	0							90
BMD-PROF02.08.03	What is the PERCENT of successful SM-3 engagements?	1	AVG	70	100-90%	89-80%	80-70%	69-0%	90
BMD-PROF02.08.04	Was Kill Assessment made for possible re-engagement?	1	AVG	Y	YES			NO	90
BMD-PROF02.08.04.01	Was there KW telemetry data after the predicted intercept time?	0							90
BMD-PROF02.08.04.02	If "No Kill," was a re-engagement planned?	0							90
BMD-PROF02.08.04.03	Were the proper voice reports made IAW current OPTASK?	0							90
BMD-PROF02.08.04.04	Were the engagement	0							90

	results transmitted via Sat Link 16?								
BMD-PROF03	Demonstrate proficiency in IBS-I	0		Rollup					90
BMD-PROF03.01	Are there two producer certified watchteams and CSTT member?	1	AVG	Y	YES			NO	90
BMD-PROF03.02	Participation in Monthly Inport Training Exercises.	0		Rollup					90
BMD-PROF03.02.01	How many unexcused MITE's were recorded in the last 90?	1	AVG	1	0			=>1	90
BMD-PROF03.03	Did the operator initialize JTT-M IAW EE130-DU-OMI-010/USQ-151 Maintenance Turn-On and Operation procedures?	1	AVG	Y	YES			NO	90
BMD-PROF03.03.01	Did the operator initialize JTT-M IAW EE130-DU-OMI-010/USQ-151 Maintenance Turn-On and Operation procedures	0							90
BMD-PROF03.03.02	Did the operator load COMSEC IAW EE130-DU-OMI-010/USQ-151 Load Key Procedures procedures	0							90
BMD-PROF03.04	Did CSC/ AWC receive IBS-S missile queuing alert from AN/USQ-151 (JTT-M)?	1	AVG	Y	YES			NO	90
BMD-PROF03.05	Was Missile Acquisition Data transmitted via AN/USQ-151 (JTT-M)?	1	AVG	Y	YES			NO	90
BMD-PROF03.05.01	Did RSC build a Dynamic Test Track (DTT) utilizing A-STATS/ ACTS	0							90
BMD-PROF03.05.02	Did unit transmit DTT over IBS-I network.	0							90
BMD-PROF04	Watch Team Level of Knowledge Exam (LOK)	0		Rollup					120
BMD-PROF04.01	Quarterly LOK exam	1	LAST	70	100-90%	89-80%	79-70%	69-0%	120
BMD-PROF04.02	ULTRA LOK exam	1	LAST	70	100-90%	89-80%	79-70%	69-0%	720
BMD-PROF04.03	Are LOK exams administered to individual watchstanders each time a new PQS qualification is attained?	1	LAST	Y	YES			NO	120

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APPENDIX B: EXAMPLE PATRIOT DRILL CARD

The following is example guidance on the assessment scoring of a Patriot Battery during certification –level events.

Performance Measures **ARTEP 44-635-13 DRILL**

___ 1 CM1 maneuver truck into position. CM2/3 assist CM1.
___ 2. CM2/3 "Halt," chock vehicle. CM1 exit vehicle.
___ 3. CM1/2 lower tailgate and position ladder. CM3 unstow two VHF whip antennas.
___ 4. CM1 Raise DLU platform. CM2/3 secure PE rack. CM2 unlock shelter.
___ 5. If required CM1/2/3 install PE. *(Evaluator has the option of waiting until after alert state assumption and system validation to issue an INTSUM or other input that initiates installation of MCPE).*
___ 6. CM3 receive and record the magnetic heading of AMG.
___ 7. CM1 open and lock all front air vents. CM2 open and lock all rear air vents. CM3 connect AMG power, control and RF cables.
___ 8. CM1 roll/secure air conditioner covers. CM2 Ensure all air vents and covers are open.
___ 9. CM1 set handle to SUMMER or WINTER position as appropriate at forward roadside water intrusion duct.
___ 10. CM1/2 unwind and carry RWCIU cable to RS.
___ 11. CM1/2 Ground ECS.
___ 12. CM1/2 retrieve and connect ECS-EPP control and power cables.
___ 13. CM1/2 prepare DLT antenna.
___ 14. CM1/2 install DLT antenna.
___ 15. CM1/2 erect DLT antenna.
___ 16. CM1 prepare ECS switches for power-up and operation. CM2 Assist CM1w/ power up and, or fiber installation. CM/3 Initialize VHF radios.
___ 17. CM1/2/3 If required, install corner reflectors. *(Evaluator has the option of waiting until after alert state assumption and system validation to issue a new communication plan or other input that requires installation of corner reflectors).*
___ 18. CM1 unstow chairs for manstations. CM2 unstow publications/documents required for initialization.
___ 19. CM1 perform DLT Init. CM2 power up LCU CM3 perform AMG circuit checks.
___ 20. CM1/2 perform DLU AN/VRC-90 quick or full load start. CM3 alignment of AMG antennas.
___ 21. CM1 verify ICOM RADIO hopset and lockout sets are loaded. CM3 connect UHF AN/GRC-103.
___ 22. CM1 verify ANCD TOD. CM3 power-up and align priority UHF AN/GRC-103.
___ 23. CM1 verify ICOM radio TOD. CM3 voice communications system cntl. Panel ops.
___ 24. CM1 verify COMSEC code is loaded.
___ 25. CM1 inform OIC the ECS is ready for initialization.
___ 26. CM1 load TACI software. CM 2 retrieve and install software.
___ 27. CM1/2 begin data acquisition.

NOTE: If mapping is performed, skip step 28.

___ 28. CM1 skip mapping. CM2 verify RS position.
___ 29. CM1 perform mapping for PTL or STLs and PTL *(The decision to perform mapping is based upon the unit's directed alert state. The type of mapping willbe based upon the current terrain).*
___ 30. CM1 observe ENTER ALTERN SEARCH CONTR DATA alert appears. Press ALERT ACK. CM2 Terminate Manual input when informed by CM1 that system is ready for TAC OPS.

___ 31. CM1 observe tab 90 (DATA COLLECTION CONTROL) appear.
___ 32. CM1 observe alert END MANUAL INPUT WITH TAB 98 appears. Press ALERT ACK at appropriate time.

___ 33. CM1 observe alert HARCOPY LS DATA—TAB 85 appears. Press ALERT ACK.
___ 34. CM1 observe alert REVIEW HARD COPY DATABASE, press ALERT ACK. Observe ALERT ACK WRITES DATABASE, press ALERT ACK to initiate writing of the database to FU disk.
___ 35. CM1 observe N symbol appears on lower left section of CRT with a line oriented toward north, relative to target line.
___ 36. CM1 observe auxiliary message STORAGE MEDIUM BUSY and alert LOAD TACT SW. Clear message and alert by pressing ALERT ACK.
___ 37. CM1 observe switches DATA COLL and DATA HRDCPY (if on) go off.
___ 38. CM1/2 load operational K7 software.
___ 39. CM1/3 standby until you commence tactical operations. CM2 direct crew to prepare for tactical operations.
___ 40. TCA/TCO ensure the ECS has been initialized and the operational software is loaded. 31R Monitor UHF and VHF radios.
___ 41. TCA/TCO select S/I's IAW TSOP. 31R check RLRIU and ensure local address is correct.
___ 42. TCA/TCO enter data in tactical tabs according to TSOP. 31R report to TCO "Ready for Action."
___ 43. TCA determine missile status by observing the missile inventory tabs and FU status panel. TCO observe FU status panel and ensure proper indications are displayed for the tactical situation.
___ 44. TCA observe BITE panel for abnormal indications. TCO evaluates operational assessment tab.
___ 45. TCA evaluates operational assessment tab. TCO ensures equipment requirements are met.
___ 46. TCA configures radar IAW directed alert state. TCO verbally reports to ICC, "ECS at battle stations with minimum engagement capability."
___ 47. TCO sends "Green Bar" to the ICC upon alert state assumption.

CM1/PCS Date:_____ Start Time: _____ Score: 100

CM2/PCS Date:_____ End Time: _____ Deducted ___

CM3/PCS Date:_____ Total Time: _____ Total ___

Evaluator: _____ Signature: _____ Date: _____

Scoring Criteria:

1. Crew must achieve a minimum passing score of 70/100 for Gunnery Table certification.
2. Point deductions:
    a. Subtract 3 points for each incorrectly executed performance measure.
    b. Subtract 6 points for each missed performance measure.
    c. Subtract 31 points for each **DANGER**, 16 points for each **WARNING**, and 10 points for each **CAUTION** violation.
    d. Subtract 31 points for exceeding maximum time for minimum engagement or alert state assumption (Table VIII- 45 min engagement / 60 min AS assumption, Table XII - 90 min min engagement / 120 min AS assumption). Any error found in Tabs 1, 5, 6, 54, 55, 70, 71, 73, 76, 78, 79, 81, 85 will result in an invalid minimum engage and alert state assumption.
    e. Subtract 31 points if equipment found to be NMC and not previously recorded.

3. Remarks:

Performance Measure	Points Deducted	Explanation for point deduction. (Include page # and step # from ARTEP Drill and any other reference)

___ 1. The commander or leader conducts friendly protection. Ensures engagement causes no friendly casualties.

___ a. IFF procedures.
___ b. Aircraft ID.
___ c. Weapon control status implementation. (WT, WF, WH)
___ d. Demonstrate understanding of Fire Control Orders:
(1) Engage
(2) Hold fire.
(3) Cease fire.
(4) Engage hold.
___ e. Demonstrate understanding of ACO.
___ f. Demonstrate understanding of TSOP.

Evaluator will ask questions

___ 2. TCO performs air battle procedures using IFF information, directions from higher headquarters, and other airspace control means.

___ a. Operates MS 3 and performs friendly protect function and weapons control function in ABT mode.
___ b. Ensures the system is in the assigned identification mode and configuration .
___ c. De-conflicts and verifies the identity of all targets.
___ d. Activates the SIF and Mode 4 IFF.
___ e. Monitors the situation display, alert line, and tabular display areas.
___ f. Implements changes which are provided to the battery party line communications.
___ g. Activates and deactivates weapons control volumes and defended assets.
___ h. Uses engagement override switches to ensure non-hostile aircraft are not engaged.
___ I. Manually activates IFF to interrogate targets.
___ j. Performs ECCM assist as directed by higher headquarters to assist in range-solving ECM tracks.
___ k. Activates manual clutter mapping.
___ l. Monitors party line for air battle communications.
___ k. Verifies TCA engagements are made according to the current weapon control status.

___ 3. TCA performs the air battle procedures using the TCO's instructions, direction from higher headquarters, and other airspace control means.

___ a. Operates MS1 and performs weapons control function during heavy TBM activity.
___ b. Ensures system is in the correct mode of control and engagement mode.
___ c. Controls system radiation based on directions provided and mission requirements.
___ d. Ensures LS OPERATE/STANDBY switches are activated as directed by Alert State.
___ e. Monitors status control panel for LS status, missile count, DEFCON, and Alert State.
___ f. Engages targets employing the ROE and supplemental fire control measures in effect.(ABT)
___ g. Activates/deactivates AREAS ENABLE.
___ f. Monitors party line for air battle communications.

___ 4. Communications operator located at MS2 performs communications functions.

___ a. Monitors/performs checks on the tactical FM & UHF circuits.
___ b. Checks DLU, RLRIU, LCU and UHF racks for operational status.
___ c. Checks AMG.
___ d. Rotates/elevates UHF antenna.
___ e. Wires communications panel per CRL.

___ 5. The TCO conducts the air battle in the centralized mode of control.

___ a. Detects, identifies, and evaluates aircraft (or TBM) in the battery's area of

responsibility.
___ b. Reports newly acquired tracks (or TBM) to the controlling authority.
___ c. Act upon all track (or TBM) assignments and tactical orders from the controlling authority.
___ d. Acknowledges the assignments, and delegates engagements to TCA.
___ e. Evaluates by SUPLANs and doctrine, unassigned high threat tracks for possible engagement.(ABT)
___ f. Enforces EMCON silent procedures.
___ g. Identifies aircraft in violation of airspace control rules.(ABT)
___ h. Ensures mission activity results are reported.
___ I. Ensures CP is informed of major activities, as time permits.
___ j. Identifies aircraft committing hostile acts and assigns them for engagement. (ABT)
___ k.Ensures engagement results are reported to the controlling authority.
___ l. Ensures a missile status report is sent to the controlling authority.

___ 6. The TCO conducts the air battle in the decentralized mode of control (ECS method of operation-in response to an order with an active data link).
___ a. Responds to an order from higher authority to go to decentralized.
___ b. Informs CP the battery is operating in the decentralized mode of control with higher authority exercising management by exception.
___ c. Detects, identifies, and evaluates aircraft (or TBM) in the battery's area of responsibility.
___ d. Reports newly acquired tracks (or TBM) to the controlling authority.
___ e. Acts upon all track (or TBM) assignments and tactical orders from the controlling authority.
___ f. Engages the targets and acknowledges receipt of assignments.
___ g. Evaluates by SUPLANs and doctrine, unassigned high threat tracks for possible engagement.(ABT)
___ h. Enforces EMCON silent procedures.
___ I. Identifies aircraft in violation of airspace control rules.(ABT)
___ j. Ensures mission activity results are reported.
___ k Ensures CP is informed of major activities, as time permits.
___ l. Identifies and assigns aircraft committing hostile acts.(ABT)
___ m. Orders the proper method of fire after an assessment of the track.(ABT)
___ n. Ensures engagement results are reported to the controlling authority.
___ o. Ensures a missile status report is sent to the controlling authority.

___ 7. The TCO conducts the air battle in the independent mode of control (ECS method of operation-in response to data link loss to higher authority).
___ a. Rapidly recognizes a loss of UHF Communications and determines the extent of communications lost.
___ b. Places battery in decentralized operations upon data link communications loss to higher HQ.
___ c. Detects, identifies, and evaluates aircraft (or TBM) in the battery's area of responsibility.
___ d. Reports newly acquired tracks (or TBM) to the controlling authority using any means available.
___ e. Assigns the targets to the appropriate FU.
___ f. Evaluates by SUPLANs and doctrine, unassigned high threat tracks for possible engagement.(ABT)
___ g. Enforces EMCON silent procedures.
___ h. Identifies aircraft in violation of airspace control rules.(ABT)
___ I. Ensures mission activity results are reported.
___ j. Ensures CP is informed of major activities, as time permits.
___ k. Identifies and assigns aircraft committing hostile acts.(ABT)

___ l. Orders the proper method of fire after an assessment of the track.(ABT)
___ m. Ensures engagement results are reported to the controlling authority.
___ n. Ensures a missile status report is sent to the controlling authority.

___ 8. The TCO conducts the air battle in the autonomous mode of control (ECS method of operation-in response to the loss of all communications with the higher authority).
___ a. Rapidly recognizes a loss of all external communications and declares the battery at autonomous mode of control.
___ b. Notifies the battery commander .
___ c. Detects, identifies, and evaluates aircraft (or TBM) in the battery's area of responsibility.
___ d. Evaluates by SUPLANs and doctrine, unassigned high threat tracks for possible engagement.(ABT)
___ e. Enforces EMCON silent procedures.
___ f. Identifies aircraft in violation of airspace control rules. (ABT)
___ g. Ensures mission activity results are reported.
___ h. Ensures CP is informed of major activities, as time permits.
___ I. Identifies and assigns aircraft committing hostile acts. (ABT)
___ j. Orders the proper method of fire after an assessment of the track.(ABT)
___ k. Ensures engagement results are reported to the controlling authority.

___ 9. TCO directs the optimal target engagement.
___ a. Assigns targets by threat priority.
___ b. Directs the FU engagement of hostile aircraft .(ABT)
___ c. Assigns OPFOR aircraft engagements IAW TSOP and TTPs.(ABT)
___ d. Allows friendly aircraft to perform their assigned missions. (ABT)
___ e. TCA will assist during all TBM operations and monitor MS1 for additional TBMs.

___ 10. TCO and TCA keep TOC updated on tactical information.
___ a. ACO.
___ b. Kills.
___ c. Missile expenditures.
___ d. Equipment status.
___ e. ECM/ECCM.
___ f. Significant air threat changes.
___ g. Equipment outage information.
___ h. Communications status.
___ I. Report any and all unusual track (ABT/TBM) type data.

___ 11. TCO and TCA notify maintenance cell of equipment outages.
___ a. Recognize equipment malfunction indication.
___ b. Respond to equipment malfunction indication.

___ 12. TCO and TCA order ECCM operations.
___ a. Report any ECM to the controlling authority, using the proper format per the MIJI report in the unit FSOP.
___ b. Conducts strobe engagements
___ c. Conducts range estimate engagements

___ 13. Implement SCUD ALERT procedures.
___ a. Battle short EPP and Radar Set.
___ b. Assume appropriate alert state and confirm switch indicators and tabs. IAW TSOP.

___ 14. Demonstrate understanding of switches, indicators, and tabs. Evaluator will ask standard questions.

CM1/PCS Date:_____ Start Time: _____ Score: 200

CM2/PCS Date:_____ End Time: _____ Deducted ___

CM3/PCS Date:_____ Total Time: _____ Total ___

Evaluator: _____ Signature: _____ Date: _____

Scoring Criteria:

1. Crew must achieve a minimum passing score of 140/200 for Gunnery Table certification.
2. Point deductions:
    a. Subtract 3 points for each incorrectly executed performance measure.
    b. Subtract 6 points for each missed performance measure.
    c. Subtract 30 points for the following:
        1) Each failure to activate / deactivate an ACO/MEZ within 30 seconds of the directed activation or deactivation time.
        2) Each hostile TBM or ABT the over runs a defended asset due to crew error.
    d. Subtract 30 points for each error made in Tab 1,5,6,54,55,70,71,73,76,78,79,81, or 85 made during the course of the air battle
    e. Subtract 61 points for each friendly aircraft engaged due to a crew error.

3. Remarks:

Performance Measure	Points Deducted	Explanation for point deduction. Include page # and step # from MTP / TSOP / FSOP and any other reference

The following Checklists are to be used by the Evaluator as a Guide Only. This checksheet will allow evaluators to easily assess whether a unit has achieved their directed AS.

Part I Alert State Verification Guide .

___ 1. Operational System (no NMC faults).
- ___ A. FP Status
- ___ B. Fault Data
- ___ C. OP Assess
- ___ D. Communications status

___ 2. Back up data base available (spare OD, hard copy).
___ 3. Alignment, emplacement and coverage of RS and LS.
___ 4. Secure FM communications capability (Btry and ADC NET).
___ 5. System and Site data books on hand.
___ 6. Configure system IAW directed alert state:
- ___ A. Minimum S/Is selected:
  - ___ (1) Weapons Control
  - ___ (2) Friendly Protect
  - ___ (3) Defend Areas
  - ___ (4) Weapon Control Areas
  - ___ (5) ID Areas
  - ___ (6) Friends
  - ___ (7) Unknowns
  - ___ (8) Hostile
  - ___ (9) Track Numbers
  - ___ (10) SIF Enable
  - ___ (11) Mode 4 Enable/Frequency Diversity
  - ___ (12) Threshold High
  - ___ (13) Radiate(TBM/ABT/Passive search) / TBM Auto Engage
  - ___ (14) Semi-Auto Engage Mode
  - ___ (15) ECCM Enable
  - ___ (16) CARM Enable
- ___ B. All available launchers in standby/ operate as directed by the ICC.
- ___ C. Ensure FP Status indicators posted IAW SSTO:
  - ___ (1) WCS
  - ___ (2) DEFCON
  - ___ (3) MOC
  - ___ (4) Alert State
  - ___ (5) ADW
- ___D. Ensure TAB entries posted IAW TSOP/ATO/SPINS:
  - ___ (1) TAB 01
  - ___ (2) TAB 02
  - ___ (3) TAB 05
  - ___ (4) TAB 06
  - ___ (5) TAB 09
  - ___ (6) TAB 14
  - ___ (7) TAB 54
  - ___ (8) TAB 55
  - ___ (9) TAB 70
  - ___ (10) TAB 71
  - ___ (11) TAB 72
  - ___ (12) TAB 73
  - ___ (13) TAB 76
  - ___ (14) TAB 78
  - ___ (15) TAB 79
  - ___ (16) TAB 81
  - ___ (17) TAB 85 (all LSs)

The Checksheet below is a reference for Evaluators only. It is to be used by the Evaluator to assess the crew's knowledge of the Patriot system. Evaluators ask questions to ensure the crew fully understands the areas oulined below

TCO/TCA Crew Proficiency/Knowledge Guide

___ 1. Demonstrate understanding of ABT/ missile threat and the EDWA process.
___ 2. ABT/TBM defense capabilities and procedures.
___ 3. ID Procedures/Rules of Engagement
___ A. ID Procedures
___ (1) ID criteria (Friendly, Hostile, Assumed Friend, Unkown)
___ (1) Manual/IFF Procedures (Manual/Auto, Garble , Mult Reply)
___ (2) Tab 73 validation
___ (3) Mode I vs. Mode IV use.
___ (4) Lame Duck Procedures.
___ B. Engagement Procedures.
___(1) ROE (Peace Time, War Time)
___ (1) Centralized
___ (2) Decentralized.
___ (3) Autonomous
___ (4) Independent
___(2) Self defense Criteria (Peace Time, War Time)
___(3) Slow Targets
___(4) ARMs
___(5) TBMs
___(6) Method of Fire (Salvo, Ripple, Modified Ripple, SLS)
____4. ECM operations (Strobe engagements, Range Assist method).
____5. Communications outage procedures:
___ A. Autonomous operations,
___ B. FU-FU operations.
___ C . Modification to SSTO.
___ 6. Denial and destruction plans.
___ 7. Missile hazard/misfire procedures.
___ 8. General Knowledge of TABS, Switch/Indicator entries.

___ (A) TAB 01
___ (B) TAB 02
___ © TAB 05
___ (D) TAB 06
___ (E) TAB 09
___ (F) TAB 14
___ (G) TAB 54
___ (H) TAB 55
___ (I) TAB 70
___ (J) TAB 71
___ (K) TAB 72
___ (L) TAB 73
___ (M) TAB 76
___ (N) TAB 78
___ (O) TAB 79
___ (P) TAB 81
___ (Q) TAB 85 (all LSs)

___ 9. Knowledge of communication plans.
___ 10. PAC3 modifications/remote launch capabilities .
___ 11. ARM Tactics/identification and CARM operations.
___ 12. STL procedures.

___ 13. Mapping procedures.(A and C)
___ 14. ECS control of launching station operations.

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